Management and Outcome of Blunt Trauma Patients: Multi-center Study

Ahmed M. Salem MD[1], Maha M. Hagras MD[2], Adel F. Al-Kholy MD[3], Ahmed Zedan MD[4], Ahmed Abdel Rahman MD[5], Mustafa A. Al-Kholy MD[6]

[1]Department of Anesthesiology & ICU, Faculty of Medicine, Benha University
[2]Department of Clinical Pathology, Faculty of Medicine, Tanta University
[3]Department of Medical Biochemistry, Faculty of Medicine, Benha University
[4]Department of General Surgery, Faculty of Medicine, Benha University
[5]Department of Neurosurgery, Ain Shams Insurance Hospital
[6]Department of Clinical Pharmacy, Benha University Hospital

Abstract

Objectives: To evaluate outcome of blunt trauma patients (TP) in relation to body region maximally injured, line of management and site of provision of treatment. Also, to evaluate at admission serum interleukin-6 (IL-6), macrophage migration inhibitory factor (MIF) and syndycan1 (Synd1) levels as outcome predictors.

Patients & Methods: 124 blunt TP were clinically evaluated to determine the Injury Severity Score (ISS). Patients requiring intensive care, surgical intervention, or both were followed up for development of complications and discharge, alive (Survivors) or dead (Non-survivors). At admission blood sample was withdrawn for ELISA estimation of serum levels of studied parameters. Outcomes included morbidity and mortality rates (MR) and its relation to admission data.

Results: Total MR was 25%. ICU admission rate was 63.7% and ICU-MR was 34.2%. MR according to body region with the highest ISS was 13.6%, 18.2%, 33.3% and 16.7% for brain, chest, abdominal and retroperitoneal injury. Forty-four TP received non-operative management (NOM), 35 TP undertook emergency and 45 had elective surgeries and management-related MR was 11.4%, 38.7% and 31.1% with significantly higher MR among patients undertook surgery versus NOM. Non-survivors were significantly older and obese with significantly higher ISS and showed significantly higher morbidities and serum IL-6, MIF-1 and Sydn1 levels than in survivors. Statistical analyses defined high serum levels of IL-6, SDN1 and MIF1, undertaking emergency surgery and high BMI as negative predictors for survival.

Conclusion: Blunt trauma is still a health problem with heavy burden on hospital resources secondary to high ICU admission rates, need for operative interference and high morbidity and MR. NOM is appropriate line of management to spare surgery whenever possible. Respiratory complications are the most pronounced ICU event with ARDS is the most common. At admission estimation of serum levels of the studied parameters could help management decision-making.

Keyword: Blunt trauma, Management, Mortality rate, Syndecan1, Macrophage migration inhibitory factor, Interleukin-6

Introduction

Trauma is steadily increasing in the modern world and constitutes public health problem worldwide [(1)]. Severe trauma is the third cause of death, in general, and the first in young population [(2)], and despite of the decline in rates of in-hospital mortality and major complications for adult trauma patients [(3)], it remained unchanged in patients with severe injuries [(4)].

Blunt abdominal trauma accounts for about 56% cases of multiple traumas of all etiologies and among multiple injured patients, near to 50% have some system-complications and more of 60% in the group are critically injured [5]. Liver trauma especially that resulting from road traffic accidents, still remains a complicated problem in severely injured patients and is associated with injuries of other organs in 72% of cases [6]. Also, thoracic trauma is one of the leading causes of morbidity and mortality with a mortality rate was 9.3% [7]. Traumatic brain injury with its associated diffuse axonal injury is becoming a major problem, particularly in the Middle East [8].

Endothelial cells line the luminal side of blood vessels, connect to the basement membrane and modulate the microvascular environment [9]. Endoluminal, the endothelial glycocalyx coats the endothelial cells and is in direct contact with the circulating blood, so plays a major role in regulation of microcirculatory flow [10]. Endothelial glycocalyx is 1-3 μm thickness fragile layer consists of proteoglycans, glycoproteins and glycosaminoglycans (GAG) [11]. GAG consists of a core membrane-bound protein of the syndecan (Synd) or glypican families with attached heparan or chondroitin sulfate side chains (GAG) [12]. Moreover, hyaluronan, a non-sulfated, uncharged GAG, is attached to cell-surface proteins (CD44) and stabilizes the glycocalyx structure by exhibiting water-retaining characteristics [13].

Macrophage migration inhibitory factor (MIF) is a central pro-inflammatory cytokine of the innate immunity and inflammatory responses [14]. MIF is an upstream immunoregulatory mediator, released by myeloid cells, that underlies a common genetic susceptibility to different infections and septic shock [15]. MIF was found to be associated with the severity and prognosis of varied traumatic injured body organs, irrespective of development of infections [16].

Objectives

Evaluation of the outcome of blunt trauma patients (TP) in relation to body region maximally injured, line of management and site of provision of treatment. Also, serum IL-6, MIF and Synd1 levels at time of admission were evaluated as predictors of outcome.

Design

Prospective comparative multi-center study

Setting

University hospitals and multiple private hospitals in Benha and Tanta in conjunction with Ain Shams Insurance Hospital, Cairo, Egypt

Patients & Methods

The study protocol was approved by the Local Ethical Committee and written consents were signed by patient him/herself or the nearest relative. All patients arrived to Emergency Department (ED) with blunt trauma during the study duration were eligible for evaluation. After obtaining demographic data and clinical history, all patients underwent clinical evaluation using the Abbreviated Injury Scale (AIS); an anatomical scoring system that evaluates injury severity of six body regions and the highest three AIS scores were squared and added to give the Injury Severity Score (ISS) which ranges between 0 and 75; and ISS≥75 indicates unsurvivable injury [(17)], so patients with ISS≥75 were excluded from the study. Patients requiring intensive care, surgical intervention, or both were followed up for development of complications and discharge from ward or ICU, alive (Survivors) of dead (Non-survivors).

Patients showed stable hemodynamic variables at time of arrival to ED were admitted to ED-observation area and received conservative treatment till either of response to conservative treatment, complete elective investigations or required surgical interference. Patients showed hemodynamic instability, could not respond to conservative treatment or in need for immediate intervention were prepared for emergency surgery after having emergency investigations, if possible. Patients showed deterioration during observation, or had definite pathology on investigations underwent elective surgical interference. All patients had surgical intervention were admitted to ICU till being stable and then discharged to ward. All drugs were checked and clearly labeled prior to administration and dosage was adjusted individually for each patient according to the clinical and laboratory data using guidelines of The Royal Australian College of Surgeons [(18)].

Investigations

At time of arrival to ED, 5 ml blood sample was withdrawn under complete aseptic conditions, allowed to clot and then centrifuged at 3000 rpm for 10 minutes to separate serum that was collected in sterile Eppindorff tube and stores at -80°C till be assayed for estimation of at admission serum levels of IL-6 [19], MIF [20] and Synd1 [21] using enzyme linked immunosorbent assay (ELISA) kits according to the manufacturer's instructions and were read using a 96 well microplate ELISA reader (Dynatech, MR 7000).

Study outcomes

1. Primary outcome is the total mortality rate (MR) at the end of the study.
2. Secondary outcomes included :
   a. Patients' distribution according to the body region severely injured which had the highest ISS and MR according to region injured.
   b. The frequency of patients admitted to ICU, directly on arrival, on deterioration of general condition or postoperatively (PO) and MR according to site of admission.
   c. Patients' distribution according to type of applied management; non-operative management (NOM) or surgical, emergency or elective and the reported MR accordingly.
   d. At admission serum levels of IL-6, MIF and Synd1 and its relation to the reported MR.
   e. The predictability of at admission age, sex, BMI, presence of associated co-morbidities, ISS and serum levels of IL-6, MIF and Synd1 for MR.

Sample size calculation

Review of literature showed that mortality rate of TP with blunt injury varies between 4.5% for NOM [22] and 15.8% [23] for operative management, to get study power of 80% with α value of 0.05 and β value of 0.2, sample size was calculated to be 111 patients.

Statistical analysis

Obtained data were presented as mean±SD, numbers and percentages. Results were analyzed using paired t-test, One-way ANOVA Test and Chi square test. Possible relationships were investigated using Spearman's correlation. Regression analysis (Stepwise method) was used for stratification of studied parameters as specific predictors for outcome. Sensitivity & specificity of evaluated parameters as predictors for patients' outcome were

evaluated using the receiver operating characteristic (ROC) curve analysis judged by the area under the curve (AUC) that was compared versus null hypothesis that AUC=0.5. Statistical analysis was conducted using the IBM SPSS (Version 23, 2015) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study comprised 151 trauma patients (TP); 27 patients were excluded for not fulfilling inclusion criteria and 124 patients were included in the study. The enrolled patients were 95 males and 29 females with mean age of 45.7±96; range 22-69 years and mean body mass index (BMI) of 29.4±5; 22.4-44.1 kg/m^2 (Fig. 1).

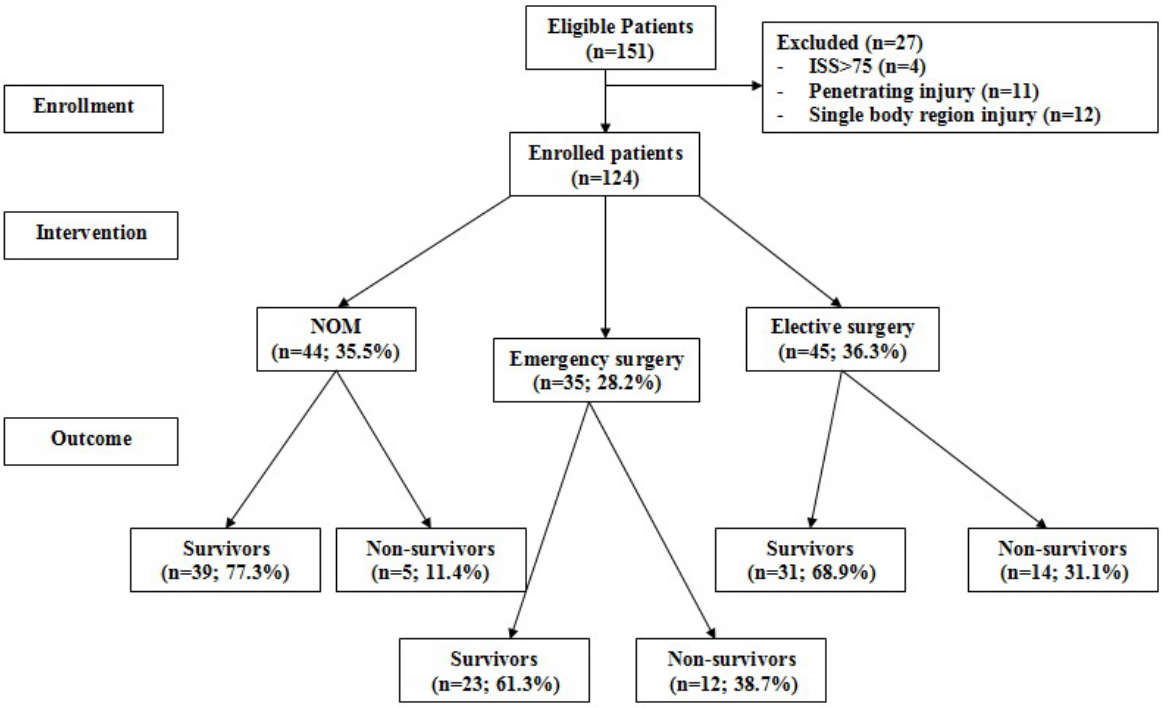

Fig. (1): Flow chart of the study

Considering the mortality rate as primary outcome, out of the total studied patients (n=124), 31 patients died for a total mortality rate of 25%. According to body region with the highest ISS, 22 patients had traumatic brain injury (TBI), 33 patients had chest injury, 57 patients had abdominal trauma and 12 patients had retroperitoneal injury. Mortality rates according to body region were 13.6%, 18.2%, 33.3% and 16.7%, respectively with non-significantly (p=0.252) higher MR among patients had blunt abdominal trauma (Table 1).

Seventy-nine patients (63.7%) were admitted to ICU; 27 patients died during ICU stay for ICU-MR of 34.2%. Forty-five patients (36.3%) were admitted to wards and 4 patients died for a ward MR of 8.9%. Mortality rate among patients admitted to ICU was significantly (p=0.0018) higher than among those admitted to surgical wards (Table 1).

Forty-four patients received NOM and only 5 patients died for a MR of 11.4%. Thirty-five patients had emergency surgeries with uneventful PO course in 23 patients, while 12 patients died for a MR of 38.7%. The remaining 45 patients had elective surgeries and 31 patients were discharged free of other morbidities or complications, while 14 patients died for a mortality rate of 31.1% with significantly (p=0.014) higher MR among patients had surgical interference compared to conservative treatment and non-significantly (p=0.437) higher MR with emergency versus elective surgery (Table 1).

Table (1): Patients' distribution according to MR in relation to injured body region, site of admission and provided management

Items			Number	Mortality rate (%)
Injured body region with highest ISS	Head		22	13.6
	Chest		33	18.2
	Abdominal		57	33.3
	Retroperitoneal		12	16.7
Site of admission	Ward		45	8.9
	ICU		79	34.2
Management	NOM		44	11.4
	Surgery	Emergency	35	38.7
		Elective	45	31.1

ISS: Injury severity score; NOM: Non-operative management

Differentially, 22 TBI patients were admitted to ICU for 48-hr observation, full investigation and conservative treatment; 16 patients had brain concussion and were discharged from ICU free of manifestations. Six patients developed manifestations of increased intracranial pressure (ICP); cranial imaging defined subdural hematoma in two patients who undertook surgical evacuation, and four undertook ICP relieving craniotomy (Table 2).

Twenty-four patients had flail chest with pneumo- or pneumo-hemothorax received under-water seal chest tube in ED theater and transferred to ward; 21 patients were discharged uneventfully after removal of the chest tube, while three patients developed complications and transferred to ICU. Four

had emergency thoracotomy for lobectomy in two and one had pneumonectomy, while the 4th had incompatible vascular injury and died in theater. Five patients had lung contusions and received observation and conservative treatment in ICU (Table 2).

Table (2): Diagnosis and management of studied patients with reference to outcome as regard survival

Diagnosis	Management	Admission at	Outcome	
			Survivors	Non-survivors
Brain concussion	NOM for 48-hr and discharged	ICU	16	0
Brain contusion	Increased ICP during NOM Relieving craniotomy		2	1
Subdural hematoma	Surgical evacuation		1	1
Brain laceration	Craniotomy to decrease ICP		0	1
Flail chest with Pneumothorax	UWS chest tube insertion	Ward	2	0
Flail chest with peumo-hemothorax	UWS chest tube & follow-up	Ward	4	1
	UWS chest tube & follow-up; thoracotomy on deterioration	Ward ICU	14 1	1 1
Closed hemothorax	Em. thoracotomy & pneumonectomy	ICU	2	1
	Em. thoracotomy reviled vascular injury	ICU	0	1
Lung contusion	NOM	ICU	3	0
	NOM	ICU	0	1
	NOM, but developed pneumonia		0	1
Diaphragmatic tear	Lap. Repair	ICU	2	0
	Lap. repair	ICU	0	1
Intraperitoneal hemorrhage	NOM for minor liver tear	Ward	5	0
	Em. laparotomy & repair of major liver tear	ICU	14	4
	Em. laparotomy & hepatectomy for severe left lobe lacerations		3	2
	Em. laparotomy right hemi lobectomy for severe lacerations		1	2
	Vascular injury		0	2
Pertonism with air under diaphragm	Lap. defunctioning colostomy for left colon perforation	ICU	3	1
	Resection & reanastomosis for small intestinal laceration		3	2
Peritonism without air under diaphragm	NOM for small mesenteric hematoma	Ward	5	1
	NOM of huge mesenteric hematoma	ICU	0	1
	Em. Lap. drainage and choledeco-jejunostomy for injured CBD		2	1
	Em. Lap. drainage and insertion of drainage tube for duodenal injury		0	2
Retroperitoneal hematoma	NOM	Ward	10	2

NOM: Non-operative management; ICP: Intracranial pressure; UWS: Underwater sealed chest tube; Em.: Emergency; Lap: laparoscopic; CBD: Common bile duct

Eleven patients with traumatic abdominal injury were managed conservatively for small intraperitoneal hemorrhage in five and small mesenteric hematoma in six. Fourteen patients had manifestations of acute abdomen; 9 had air-under diaphragm, 4 patients undertook laparoscopic defunctioning colostomy for left colon perforation, and five had resection & re-anastomosis for small intestinal lacerations. The other five had no air-under diaphragm and undertook emergency laparoscopy for drainage and insertion of drainage tube for duodenal injury in two and for choledeco-jejunostomy in three patients. Twenty-six patients presented by intraperitoneal hemorrhage and had had emergency laparotomy for repair of major liver tear in 18 patients, left lobectomy in 5 patients and three had right hemi lobectomy for severe lacerations. Additionally, 3 patients had diaphragmatic tears and undertook laparoscopic repair, two patients had intraperitoneal hemorrhage secondary to vascular avulsion and one patient had huge mesenteric hematoma. Twelve patients had retroperitoneal hemaoma and received conservative treatment in ward (Table 2).

Non-survivors were significantly older (p=0.013) and obese (p=0.0017) with non-significantly higher frequency of males (p=0.166) and associated co-morbidities (p=0.057) than survivors. Fifty-five patients has ISS≥50, 63 patients had ISS ranging between 25 and 50 and only 6 patients had ISS of <25 with significantly higher frequency of patients had high ISS and significantly higher mean ISS in non-survivors than in survivors (Table 3).

Table (3): Enrolment data of studied patients categorized according to survival

Parameters		Total	Non-survivors	Survivors	P value
Number		124	31 (25%)	93 (75%)	
Age (years)		45.7±9.6	49.4±8.4	44.5±9.7	0.013
Gender	Males	95 (76.6%)	25 (80.6%)	70 (75.3%)	0.166
	Females	29 (23.4%)	6 (19.4%)	23 (24.7%)	
Weight (kg)		83.1±12.9	89.9±14.7	80.8±11.4	0.0005
Height (cm)		169.2±3.7	168.1±2.2	169.5±4	0.056
BMI (kg/m^2)		29±4.3	31.9±5.1	28.6±4.7	0.0017
Associated medical diseases	Yes	21 (16.9%)	8 (41.9%)	11 (8.6%)	0.057
	No	103 (83.1%)	18 (58.1%)	85 (91.4%)	
ISS	<25	6 (4.8%)	0	6 (6.5%)	0.033
	25-<50	63 (50.8%)	11 (35.5%)	52 (65.3%)	
	≥50	55 (44.4%)	20 (64.5%)	35 (28.2%)	
	Total	48.4±12.8	54.3±9.4	46.5±13.3	0.0028

Data are shown as mean±SD, numbers, percentages; p value indicates significance of difference between survivors and non-survivors; p value <0.05 indicates significant difference

The frequency of management related complications was $54.8x10^{-2}$/ patient with significantly (p<0.001) higher frequency among non-survivors ($155x10^{-2}$/patient) versus survivors ($21.5x10^{-2}$/patient). Respiratory complications were the most frequent ($29.8x10^{-2}$/patient) and septic complications ($14.5x10^{-2}$/patient) with significantly (p<0.001). The frequencies of other complications showed non-significant (p>0.05) difference between survivors and non-survivors (Table 4).

Table (4): Management-related complications encountered during observation period

Complications		Total (n=124)	Non-survivors (n=31)	Survivors (n=93)
Respiratory	ARDS	23 (18.5%)	15 (48.4%)	8 (8.6%)
	SIRS	12 (9.7%)	9 (29%)	3 (3.2%)
	RF	2 (1.6%)	2 (6.5%)	0
Cardiac	MI	3 (2.4%)	2 (6.5%)	1 (1.1%)
Renal	ARF	4 (3.2%)	3 (9.7%)	1 (1.1%)
Bleeding	Acute	3 (2.4%)	3 (9.7%)	0
	Reactionary	3 (2.4%)	2 (6.5%)	1 (1.1%)
Septic	Sepsis	14 (11.3%)	9 (29%)	5 (5.4%)
	Septic shock	4 (3.2%)	3 (9.7%)	1 (1.1%)
Total		68	48	20
Frequency (complication/patient)		$54.8x10^{-2}$	$155x10^{-2}$	$21.5x10^{-2}$

ARDS: Adult respiratory distress syndrome; SIRS: Systemic inflammatory response syndrome; ARF: Respiratory failure; MI: Myocardial infarction; ARF: Acute renal failure

Estimated serum IL-6, MIF and Synd1 levels were significantly higher in patients than in controls and in non-survivors than in survivors (Table 5). Survival showed negative significant correlation age, BMI, ISS, ICU admission and higher levels of Synd1, MIF and IL-6 (Table 6). Regression analysis defined high serum levels of IL-6, SDN1 and MIF, undertaking emergency surgery and high BMI as negative predictors for survival in decreasing order of significance (Table 7). ROC curve analysis defined high serum levels of Synd1, MIF and IL-6, BMI as the significant predictors for mortality, in decreasing order of significance (Table 7, Fig. 2).

Table (5): Enrolment data of studied patients categorized according to survival

Parameter	Total	Non-survivors	Survivors	P value
IL-6 (ng/ml)	48.45±40.96	112±19.67	27.25±17.33	<0.001
MIF (ng/ml)	6.985±4.08	11.8±3.65	5.38±2.74	<0.001
Syndecan1 (ng/ml)	102.5±57.55	179.52±63.11	76.86±21.6	<0.001

Data are shown as mean±SD; IL-6: Interleukin-6, MIF: Macrophage migration inhibitory factor; p value indicates significance of difference between survivors and non-survivors; p value <0.05 indicates significant difference

Table (6): Spearman correlation coefficient (Rho factor) between survival and studied variables

	Age	Male gender	BMI	Ass. morbidities	ISS	Emergency surgery	ICU admission	IL-6	MIF	Synd1
Rho	-0.254	0.165	-0.282	-0.168	-0.261	0.134	-0.281	-0.592	-0.620	-0.719
p	0.004	0.067	0.002	0.062	0.003	0.136	0.002	<0.001	<0.001	<0.001

Rho: Spearman coefficient; BMI: Body mass index; ISS: Injury Severity Score; IL-6: Interleukin-6, MIF: Macrophage migration inhibitory factor; Synd1: Syndecan1; p value <0.05 indicates significant value

Table (7): Regression & ROC curve analyses of studied variables as predictors of survival

Method	Regression analysis		ROC curve analysis		
Variables	β	P	AUC (±SE)	P	95% CI
BMI	-0.167	<0.001	0.688 (±0.048)	0.002	0.594-0.782
IL-6 (ng/ml)	-0.412	<0.001	0.895 (±0.045)	<0.001	0.807-0.982
MIF (ng/ml)	-0.300	<0.001	0.913 (±0.03)	<0.001	0.854-0.973
Synd1 (ng/ml)	-0.412	<0.001	0.979 (±0.011)	<0.001	0.957-1.000
Emergency surgery	-0.183	<0.001	0.570 (±0.061)	<0.001	0.450-0.690

BMI: Body mass index; IL-6: Interleukin-6, MIF: Macrophage migration inhibitory factor; p value <0.05 indicates significant value

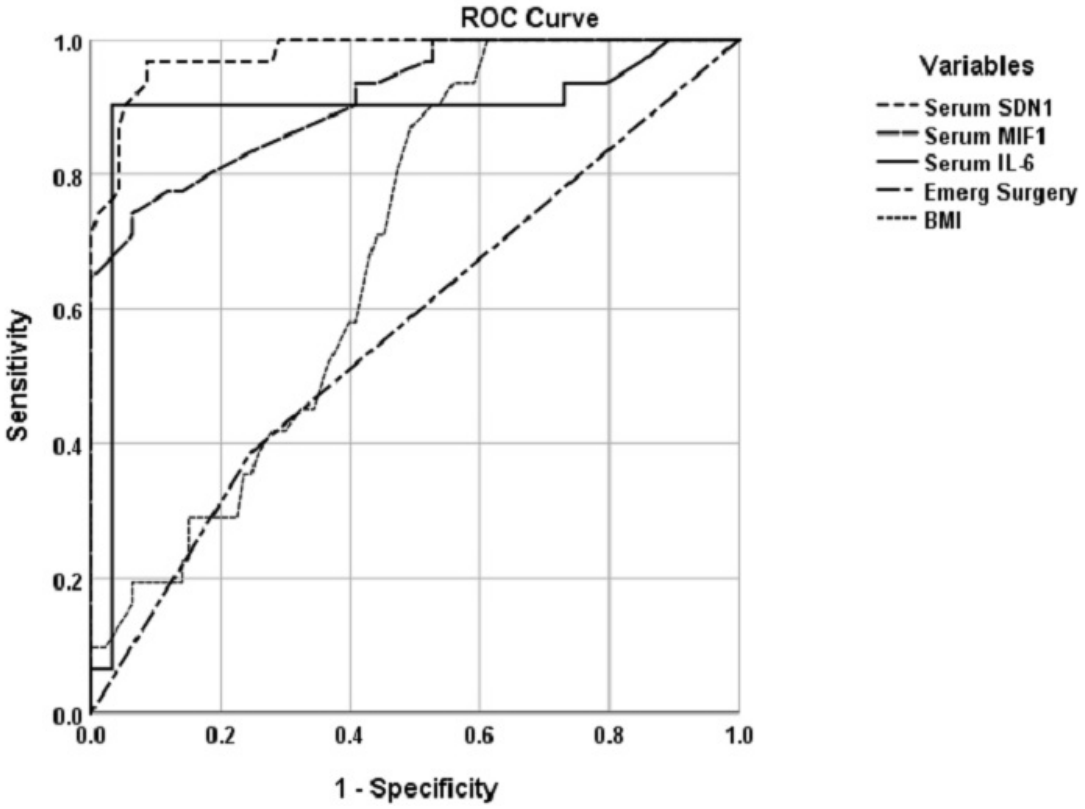

Fig. (1): ROC curve analysis of BMI, emergency surgery and laboratory data as predictors for mortality of blunt trauma patients

Discussion

Non-operative management (NOM) was tried with 45 TP; 11 with abdominal injury having small intraperitoneal hemorrhage or small mesenteric hematoma, 12 patients with retroperitoneal hemaoma and 22 with TBI; the reported MR with NOM was significantly (p=0.009) lower than with operative management (11.4% vs. 32.5%). In support of the application of NOM in trauma patients, **Navsaria et al.** [24] reported that NOM of carefully selected patients with gunshot liver injury is safe and associated with minimal morbidity. Moreover, **Armstrong et al.** [25] documented safe application of NOM to traumatic splenic injury patients with unstable hemodynamic measures, especially in low-grade injuries and **Barbier et al.** [26] documented that NOM is possible in most blunt liver injury with a success rate of 96%.

Trauma constitutes a burden on hospital resources, as 79 patients, constituting 63.7% of studied population, were admitted to ICU and traumatic abdominal injury constitutes about 65.8% of those admitted to ICU. ICU-MR was 34.2%, while MR among patients admitted to ward was 8.9%. **Mabry et al.** [27] found patient care cost rose with increasing ISS, length of stay, ICU days, and ventilator days for trauma patients.

According to body region with the highest ISS, MR was highest among patients had traumatic abdominal injury (33.3%), while was 18.2%, 16.7% and 13.6% in chest, retroperitoneum and brain, respectively. In line with these findings, **Mörs et al.** [28] found Abbreviated Injury Scale (AIS) ≥3 of chest and abdominal body regions were significantly higher among trauma patients and in males than in females.

Collectively, non-survivors were significantly older and obese with higher frequency of high ISS and mean ISS than in survivors. Moreover, the frequency of male patients and patients with associated co-morbidities was non-significantly higher among non-survivors than survivors. These findings go in hand with **Glance et al.** [29] who found the likelihood to have major complications was increased twice in severely obese trauma patients with at least 30% increase in possibility to die than non-obese TP. Also, **Schieren et al.** [30] detected a negative impact of obesity on outcomes after blunt chest trauma, as it is associated with prolonged duration of mechanical ventilation, ICU and hospital length of stay. Moreover, **Stroud et al.** [31] reported that obese TP present with different injury patterns compared to lean patients and this significantly increased the burden on resource requirements and have negative impact on patient outcomes.

Estimated serum IL-6, MIF and SDN1 levels were significantly higher in non-survivors than survivors. Survival showed negative significant correlation with age, BMI, ISS, ICU admission and higher levels of SDN1, MIF and IL-6. Statistical analyses defined high serum levels of IL-6, SDN1 and

MIF, undertaking emergency surgery and high BMI as negative predictors for survival. Similarly, **Mörs et al.** [28] detected significantly higher serum IL-6 and SIRS and sepsis among TP especially males and non-survivors and concluded that higher systemic IL-6 levels after trauma are associated with enhanced susceptibility for SIRS and sepsis especially in male patients. Also, **Bank et al.** [32] reported significantly elevated MIF and IL-6 in subjects with acute spinal cord injury compared to control subjects. Thereafter, **Okeny et al.** [33] detected significant positive association between serum IL-6 levels and injury severity, irrespective of duration of injury and **Kurt et al.** [34] reported that multiple rib fractures and pulmonary contusions with subsequent systemic lung inflammation after blunt chest trauma lead to local and systemic inflammation with significant increases of serum IL-6.

Thereafter, **Yang et al.** [16] detected significantly increased serum levels of CRP, IL-6, TNF-α and MIF in TBI patients than controls with a positive significant correlation between concentration of these parameters and WBC count and Glasgow coma scale. Also, **Chio et al.** [35] experimentally reported that TBI causes neurological deficits associated with stimulating several pro-inflammatory genes profiles including IL-6 and MIF but inhibiting several anti-inflammatory gene profiles of cytokines and chemokines and **Cho et al.** [36] clinically found TP with elevated serum MIF showed high serum CRP and consume significantly longer duration of ICU stay than patients had low MIF levels.

Recently, **Ikeda et al.** [37] reported that serum Synd-1 levels were significantly higher in septic patients than healthy controls and in non-survivors than in survivors with significant correlations with APACHE II, SOFA, and disseminated intravascular coagulopathy scores, and serum levels of hemostatic markers, IL-1β and 8. Also, **Smart et al.** [38] reported that increased Synd-1 was significantly correlated with neutrophil activation biomarkers and significantly increased the odds of respiratory failure, need for mechanical ventilation and 30-day mortality. **Wei et al.** [39] reported that in severely injured adult TP elevated Synd-1 status; ISS and total blood transfused were significantly associated with an increased likelihood of developing sepsis. **Osuka et al.** [40] found at admission serum Synd-1 level was significantly higher than in healthy volunteers, significantly associated with patient age and fluid requirement and was an independent parameter for development of burn-induced compartment syndrome

Conclusion

Blunt trauma is still a health problem with heavy burden on hospital resources secondary to high ICU admission rates, need for operative interference and high morbidity and mortality rates. NOM is appropriate line of management to spare surgery whenever possible. Respiratory complications are the most pronounced ICU event with ARDS is the most common. At admission

estimation of serum levels of the studied parameters could help management decision-making. However, wider-scale studies are mandatory to establish cutoff points for laboratory markers to define the hazard of mortality of blunt TP.

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