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Original article

Predictors of Mortality in Patients with Isolated Chest Trauma

Ibrahim Fadl Mahmoud [1]; Mohamed A. Ahmed Aglan [2]; Mohammad Seddiek A. Esmaiel [3]; Gamal Abdelshafy Ibrahim Farag [3]; Badr Esmail Elfar [4]; Saud Mohamed Erwy [5]

Department of Anesthesiology, Intensive Care and Pain Medicine, Damietta Faculty of Medicine, Al-Azhar University, Egypt [1]
Department of Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Al-Azhar University, Egypt [2]
Department of Cardiothoracic Surgery, Damietta Faculty of Medicine, Al-Azhar University, Egypt [3]
Department of Anesthesiology, Intensive Care and Pain Medicine, Faculty of Medicine, Al-Azhar University, Egypt [4]
Pulmonologist and Intensivist at Armed Forces Hospital, Jazan, Suadi Arabia [5]

Corresponding author: Ibrahim Fadl Mahmoud
Email: dr_ifm@yahoo.com

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ABSTRACT

Background: Chest trauma remained an important type of trauma that carries the risk of morbidity and mortality. The Modified Early Warning Score [MEWS] is a unique score as it is a physiological and simple score which permits improvement in the patient management.

The aim of the work: To assess frequency, risk factors of mortality and examine MEWS as a predictor of mortality in patients with isolated chest trauma.

Patients and Methods: Prospective analysis of 157 patients presented to emergency department, with isolated chest trauma. Demographic data, MEWS, trauma characteristics, and laboratory data were recorded on admission. The patients received standard management and were followed up until discharge or death.

Results: Age of patients ranged from 4 to 79 years. Male constituted 79.6%. About 29% admitted with penetrating chest trauma. About 98% and 82% presented within 24 hours and had unilateral chest trauma. MEWS of them ranged from 0 to 12. There is a significant relationship between mortality and hemoglobin levels, length of hospital stay and MEWS. There is a non-significant relationship between mortality and gender, type of trauma or duration of admission. Unilateral trauma indefinitely protects against mortality. MEWS [≥7] and length of hospital stay [≥4 days] increase mortality risk by 127.3 and 4.7 folds respectively. The cutoff of MEWS for prediction of mortality was ≥ 6.5, with sensitivity of 100%, specificity of 84.9%, [p<0.001].

Conclusion: High on-admission MEWS ≥7, late presentation after 24 hour and bilateral injury were risk factors of mortality in isolated chest trauma.

Keywords: Predictors; Chest trauma; Mortality; Modified Early Warning Score; Risk factors.

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* Main subject and any subcategories have been classified according to the research topic.

INTRODUCTION

Trauma is an important medical issue as it is associated with high rate of morbidity and mortality regardless of the development level of country. Thoracic trauma [TT] represents 15 - 20% of all reported injuries [1-2]. TT is accountable for about 25% of trauma-related deaths. Blunt TT is more prevalent than penetrating trauma. Blunt TT is usually due to road traffic accidents [RTA], falling from height, and different crush injuries [3-4].

Thoracic trauma is capable of causing immediate life-threatening injury, which we must recognize and manage through primary survey and resuscitation. Immediate deaths are frequently attributable to ruptured myocardial wall or thoracic aorta [5].

Early deaths [occurred in the first 30 minutes to three hours] due to TT are frequently preventable. Causes of early deaths are tension pneumothorax, cardiac tamponade, airway obstruction and uncontrolled bleeding. These causes are usually reversible or may be treated conservatively. Thus, it is crucial for emergency physicians to be completely familiar with their mechanisms, clinical presentation and management [5].

The ideal management should be multidisciplinary and should start before arrival at the hospital and continued throughout transport, in the emergency department, the operating theater and then in the ICU. Early diagnosis and early management are also crucial for reduction of the related-morbidity and mortality rates [6].

The Modified Early Warning Score [MEWS] may share in improvement of the quality and safety or provided treatment. It is a simple and a physiological score. The NEWS developed to prevent the delay in intervention or transfer of critically ill patients [7].

AIM OF THE WORK

Aim of the study was to assess the frequency and risk factors of mortality among patients with chest trauma and also to assess performance of MEWS in prediction of mortality among those patients.

PATIENTS AND METHODS

A prospective study was held in Al-Azhar University Hospitals, and Armed Forces Hospital [Jazan]. gearing period from May 2020 to December 2020. All patients, whatever their age or sex, presented with only chest trauma; either blunt or penetrating were included.

The study protocol was approved by the Local Research and Ethics Committee of Al-Azhar Faculty of Medicine [New Damietta] and Armed Forces Hospital [Jazan], and all patients provided informed consent for participation in this work.

The primary outcome was defined as the occurrence of mortality.

The operational design:

Data of the studied patients were collected from them, their guardians or from records. Detailed data about the cause, mechanism of injury were collected. Modified early warning score [MEWS] on presentation, investigation findings and outcome. Vital signs, laboratory data and imaging techniques, and management techniques were performed to patients according to their medical need without interfering with the current research.

The patients were followed up until discharge or death and length of stay was recorded. Modified Early Warning Score: The MEWS is designed to improve communication between nursing and junior doctors staff and to 'flag-up' patients who require an immediate intervention. Its advantages include simplicity reproducibility, non-invasiveness, and its use as a monitor of the patient's clinical condition.

The assessed parameters include pulse, respiratory rate, temperature [°C], consciousness level or AVPU score, systolic blood pressure, and urine output [7].

The score for each variable is recorded at the observation time. If the total score is equal to or above 4, the ward doctor was informed.

Administrative design and the ethical consideration: The study was approved by the Ethical Committee of the Faculty of Medicine, Al-Azhar University [Damietta]. An informed consent was obtained from patients or their guardians if their condition did not allow free informed consent to be taken after explaining objectives of the study. The confidentiality of data was assured.

Table 1: Modified Early Warning Score [8]

	3	2	1	0	1	2	3
RR		≤8		9-20		21-30	>30
HR		≤40	41 - 50	51-100	101-110	111-129	>129
SBP [mmHg]	≤70	71-80	81-100	101-199		≥200	
Urine output	<10ml/h	<20 ml/h for >2h	<30ml/hr For >2h	30 ml/h	On dialysis	Not voided for 8 h	Not voided for12 h
Temperature		≤35	35.1 - 36	36.1 - 38	38.1–38.5	≥38.6	
Neurological [AVPU]				Alert 15	React to voice [14]	React to pain 9 - 13	Unresponsive <9

Statistical analysis: Data analysis was conducted by SPSS [Statistical Package for the Social Sciences] software version 20. Quantitative variables were represented by their means and standard deviations. Qualitative variables were described by their absolute numbers and relative frequencies and were compared using Chi square test. Kolmogorov-Smirnov [distribution-type] and Levene [homogeneity of variances] tests were used to verify assumptions for use in parametric tests. To compare means of two groups, the independent sample "*t*" test was used for normally distributed data and Mann Whitney test was used when data is not normally distributed. The receiver operation curve [ROC] curve was used to determine the best cutoff of the studied parameters in the diagnosis of certain health problems. The level of statistical significance was set at 5% [*P*<0.05]. A highly significant difference was present if p≤0.001

RESULTS

The age of the studied patients ranged from 4 to 79 years with a median of 38 years. Male constituted 79.6% of them. Forty six patients admitted with penetrating chest trauma [29.3%]. The largest percentage of the patients had been admitted for <24 hours [98.1] and had unilateral chest trauma [81.9%] [Table 2].

Road traffic accident represented the most common mechanism of injury [55.4%] whereas about one third had chest trauma as they were driving a car. About 68% of patients had accidental injury [Table 2]

MEWS of them ranged from 0 to 12 with mean [±SD] 4.57 [±2.71]. They stayed at hospital for 1 to 7 days with a mean [±SD] 4.14 [± 1.73] days. Hemoglobin level of them ranged from 7 to 13 g/dl with mean10.89 g/dl [Table 2]. Seven percent of the studied patients died by the end of the study [Figure 1].

There is significant relation between patient outcome and hemoglobin level [lower in patients died by the end], the length of hospital stay and MEWS [higher in patients died by the end]. However, there is statistically non-significant relation between outcome and patient age [Table 3].

There is statistically non-significant relation between patient outcome and both gender, type, mode of trauma or duration of admission. On univariate analysis, male gender, penetrating trauma, the criminal mode and admission for ≥ 24 hours increase mortality risk by 1.16, 1.42, 1.87 and 7.2 respectively. There is significant relation between patient outcome and severity of trauma, the length of hospital stays and MEWS [higher in patients died by the end]. MEWS [≥7] and unilateral chest trauma were associated with survival [COR=0]. The length of hospital stay [≥4 days] significantly increased mortality risk by 4.7 fold [Table 4].

On conducting a backward logistic regression analysis of factors associated with mortality, unilateral chest trauma was independent protector [AOR=0, p>0.05] [Table 5]. The best cutoff of MEWS in prediction of mortality ≥ 6.5 with area under curve 1, sensitivity at this cutoff was 100%, specificity 84.9%,

positive predictive value 33.3%, negative predictive value 100%, positive likelihood ratio 6.62, negative likelihood ratio 0, accuracy 86% [p<0.001] [Table 6, figure 2].

Table [2]: Distribution of the studied patients according to demographic characteristics and clinical data

	Variables	N=157	%
Age [years]	Mean ± SD	37.86 ± 20.39	
	Range	38 [4 – 79]	
Gender	Male	125	79.6
	Female	32	20.4
Type of injury:	Blunt	111	70.7
	Penetrating	46	29.3
Mechanism of injury:	Road traffic accident	87	55.4
	Pedestrians	10	6.4
	Drivers [motor vehicle]	52	33.1
	Motorcyclist	25	15.9
	Assault	50	31.8
	Sport injuries	20	12.8
Mode of trauma:	Accidental	107	68.2
	Criminal	50	31.8
Duration of admission:	<24 hour	154	98.1
	≥24 hour	3	1.9
Severity of trauma:	Unilateral	127	80.9
	Bilateral	30	19.1
Outcome:	Dead	11	7
	Alive	146	93
MEWS:	Mean ± SD	4.57 ± 2.71	
	Range	4 [0 – 12]	
	<7	124	79
	≥ 7	33	21
Hospital stay:	Mean ± SD	4.14 ± 1.73	
	Range	4 [1 – 7]	
	< 4 days	96	38.9
	≥ 4 days	61	61.1
Hemoglobin [g/dl]:	Mean ± SD	10.89 ± 1.34	
	Range	11 [7-13]	
	<10 g/dl	52	33.1
	≥ 10 g/dl	105	66.9

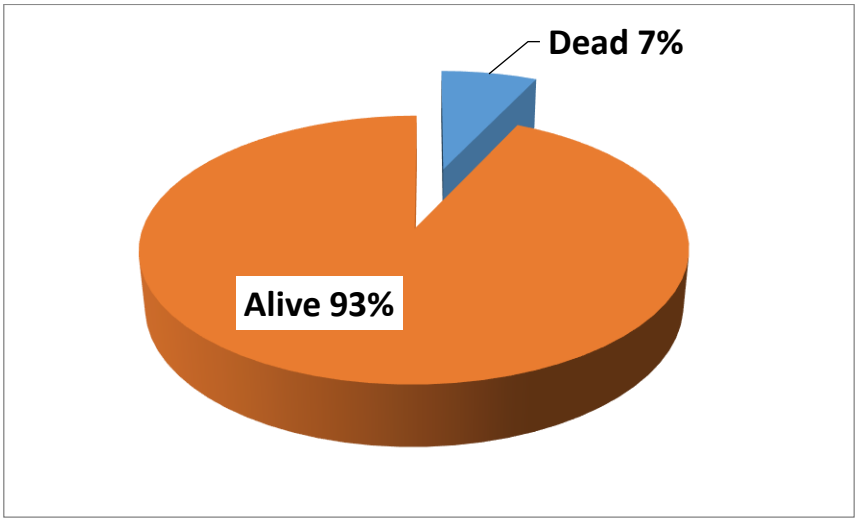

Figure [1]: Pie chart showing the distribution of patients under the study according to outcome

Table [3]: Relation between patient outcome and age, hemoglobin level, MEWS and length of hospital stay

Variables		Outcome		Test	
		Dead	Alive	*Z/t*	p
		N=11[%]	N=146[%]		
Age	Mean ± SD Range	42.36±24.53 54 [6 -77]	37.52±20.11 37.5 [4-79]	-0.763	0.445
Hemoglobin	Mean ± SD Range	8.45±1.29 7 - 11	11.07±1.15 7 - 13	-7.126	<0.001**
Hospital stay duration	Mean ± SD Range	2.45±1.21 2 [1-4]	4.27 ± 1.7 4 [1 – 7]	-3.299	<0.001**
MEWS	Mean ± SD Range	11±0.78 10 -12	4.08±1.7 0 - 8	23.673	<0.001**

*p<0.05 is statistically significant **p < 0.001, statistically highly significant, " *t*" Independent sample student test, Z: Mann Whitney test

Table [4]: Univariate analysis of the prognostic factors among the studied patients

Variables		Total	Outcome		p	COR [95% CI]
			Dead	Alive		
			N=11[%]	N=146[%]		
Gender	Male Female	125 32	9 [7.2] 2 [6.3]	116 [92.8] 30 [93.7]	>0.999	1.16[0.24-5.67]
Type of injury	Blunt Penetrating	111 46	7 [6.3] 4 [8.7]	104 [93.7] 42 [91.3]	0.732	1.42 [0.39– 5.09]
Mode of trauma	Accidental Criminal	107 50	6 [5.6] 5 [10]	101 [94.4] 45 [90]	0.315	1.87 [0.54– 6.45]
Duration of admission	<24 hour ≥24 hour	154 3	10 [6.5] 1 [33.3]	144 [93.5] 2 [66.7]	0.197	7.2[0.6 – 86.37]
Severity of trauma	Bilateral Unilateral	30 127	11 [36.7] 0 [0]	19 [63.3] 127 [100]	<0.001**	0
MEWS	<7 ≥ 7	124 33	0 [0] 11 [33.3]	124 [100] 22 [66.7]	<0.001**	0
Length of hospital stay	<4 ≥ 4	96 61	3 [27.3] 8 [72.7]	93 [63.7] 53 [36.3]	0.024*	4.7 [1.2 – 18.4]*

*p<0.05 is statistically significant **p < 0.001, is statistically highly significant COR crude odds ratio CI Confidence interval

Table [5]: Multivariate analysis of factors associated with mortality among patients with chest trauma

Factors	β	p	AOR	95% C.I.	
				Lower	Upper
Unilateral chest trauma	-20.065-	0.995	0.000	0.000	.

Table [6]: Performance of MEWS score in prediction of mortality among the studied patient

Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	+LR	-LR	Accuracy	p
6.5	1	100	84.9	33.3	100	6.62	0	86	<0.001**

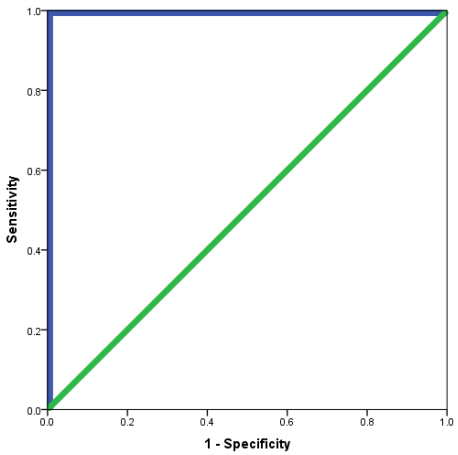

Figure [2] ROC curve showing performance of MEWS score in prediction of mortality among the studied patients

DISCUSSION

Chest trauma triggered mortality among 7% of the patients. Former studies conveyed that the mortality rate ranged from 2.2% to 33% [8-11]. However, the mortality rate was 10 and 12.5% in previous Egyptian studies which was in approximate to the current findings [12- 13]. This can be attributed to heterogeneity of chest trauma regarding severity and differing managing algorithm and facilities between different countries

The current study denoted that mortality was non-significantly associated with higher age. Male gender non-significantly increased risk of mortality. This agreed with a previous study in Nigeria [8]. However, a previous study reported that older age was linked with mortality among patients with chest trauma [14].

This study showed that the ratio of blunt to penetrating trauma was 70:29. A comparable findings agree with previous study, regarding the proportion of the two main categories of chest trauma. The blunt trauma was more common than penetrating type [8,10]. It was close to that reported in another study where the ratio was 65%:35%. Penetrating trauma represented 33% of total TT [15].

Other studies had documented rates between 3:1 to 70:1 [10,15]. Penetrating trauma non-significantly increased risk of mortality by 1.42 folds. This agreed with other studies [8-10].

The criminal mode was non-significantly increased mortality risk which can be attributed to severity of trauma and using full power and intension of the criminals to induce harm more than expected in accidental trauma. Mortality significantly depended on the extent of involvement. Unilateral chest trauma indefinitely protects against mortality in both univariate and multivariate analysis in agreement with Ekpe *et al*. [8].

For explanation, the pathophysiological changes of bilateral injury seems to be double when compared to unilateral involvement. The effects could include pain, diaphragm splinting, respiratory distress, the use of additional accessory muscles, use of abdominal muscles, oxygen levels and arterial desaturation. All are expected to be doubled in bilateral than unilateral trauma.

The current study suggests a cutoff of 7 or less to predict mortality among patients with accuracy of 86%. This cutoff is by far lower than that reported in the study by Ekpe [8], 141 patients had MEWS score of ≤ 9 and were survived, whereas the other eight patients were died [they had high MEWS > 9].

Delay in presentation to our centers more than 24 hours non-significantly increased the risk of mortality by 7.2 folds in disharmony with Saad [11]. Also it is identified as an independent risk factor for mortality among TT patients in the study yet with a statistically significant difference [P = 0.0001]. Lema *et al*. [10] failed to find the delay in presentation of patients with TT beyond 24 hours to affect the length of stay in ICU and mortality but still believed that it does because the complications rate was found to affect both length of stay and mortality.

The study carried some strength points. Patients with isolated chest trauma were included so this removed confounder that other trauma type may cause mortality not merely chest trauma

The study had some limitations. Only we associated baseline data on admission with patient outcome. The relatively small sample size as only patients with isolated chest trauma were only included. Also heterogeneity of patients' data as the sample included children, teenagers, adults and elderly.

Conclusion:

The best cutoff of MEWS in the prediction of mortality in patients with isolated chest trauma ≥ 6.5. High on-admission MEWS score ≥7, late presentation after 24 hour and bilateral chest involvement were found to be risk factors of mortality in the isolated chest trauma.

Financial and Non-financial Relationships and Activities of Interest

None

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