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Prediction of Severity in Patients with Surgical Trauma of the Thorax, Abdomen and Pelvis

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Abstract

Objective: To determine early severity in patients with surgical trauma of the thorax, abdomen and pelvis.

Methods: Cross-sectional study at the Hospital José Carrasco Arteaga Cuenca-Ecuador (2018-2020). Seventy-one patients met the inclusion criteria. We studied demographic variables, vital signs and blood tests. The dependent variable was admission to the ICU. All values were taken at patient admission, frequencies, percentages, measures of central tendency, or (95% CI) were performed.

Results: Male patients represented 83.1%; the mean age was 31 years, the mean time to hospital was 36 min. 81.7% presented blunt trauma and the main cause was traffic accidents (57.7%). Furthermore, 38% of patients required a transfusion, the main cause being traffic accidents (57.7%). 38% required a blood transfusion.

The risk factors that were significant in predicting severity were: HR greater than 100, MAP less than 70, SBP less than 90, Excess base greater than -6, pH less than 7.25, PT greater than 14.5, bicarbonate less than 17.5. Mortality was 5.6%.

Conclusion: early predictors of severity in surgical trauma of the thorax, abdomen and pelvis will allow taking measures upon admission of a traumatized patient, with simple and accessible parameters.

Keywords: Hemorrhage; Shock; Hypovolemia; Trauma

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Introduction

Hypovolemic shock secondary to traumatic injuries is one of the main causes of morbidity and mortality, especially in young people. It accounts for more than five million deaths each year. 30% to 40% of these deaths are associated with uncontrolled bleeding [1-3]. It is the second leading cause of shock, after septic shock. Up to one third of trauma patients have signs of coagulopathy on admission to hospital. Trauma-induced coagulopathy is associated with increased blood transfusion, complications and mortality [2,4,5,].

Shock is an urgent and potentially fatal clinical alteration, in which there is a failure of the circulatory system that prevents adequate perfusion of tissues. Therefore, there is no proper oxygenation and nutrient supply. At the cellular level, the lack of oxygen results in a change from aerobic to anaerobic metabolism, producing a consequent lactic acidosis. Its effects are initially reversible, but if the cause is not corrected, they can progress to an irreversible situation such as multiorgan failure and death [3-6].

It is one of the most frequent complications in patients admitted to the ICU (Intensive Care Unit) with an incidence of up to 33% [7]. The delay in early identification of patients with active bleeding delays the application of therapies that are essential for bleeding control [2,8,9].

The scarce number of trauma care centers, accompanied by disproportionate population growth,

makes Medicare coverage lower [10]. Early detection of shock and adequate resuscitation is essential to achieve better patient outcomes. Predicting the severity of trauma helps the emergency team to make timely clinical and surgical decisions in a polytraumatized patient.

Material and Methods

After approval of the protocol by the teaching and research department of the José Carrasco Arteaga Hospital in the city of Cuenca-Ecuador, a retrospective cross-sectional study was conducted in which patients were taken from 2018 to 2020. Seventy-one patients (n=71) met the inclusion criteria (abdominal or pelvic thoracic trauma requiring surgical treatment). The variables studied were age, sex, cause and type of trauma, vital signs, blood tests. The dependent variable was ICU admission. All values were taken at patient admission to the emergency room. We performed frequencies, percentages, measures of central tendency. Regarding the search for association of or variables with 95% CI, a p value of less than 0.05 was taken for statistical significance.

Results

Demographic variables

We found a larger male population (83.1%), mean age was 31 ± 15.6 SD. The time of arrival at the emergency room was 36.3 ± 0.45 SD. Most patients presented blunt trauma (81.7%). 57.7% suffered a traffic accident (Table 1).

Surgical variables and bleeding markers

Thirty-eight percent (n=27) of the patients required blood transfusion. Tranexamic acid was applied to 52.1% (n=37) of the population. FAST (Focused Abdominal Sonography for Trauma) was performed on 40 patients, of which 50% were positive. On the results of Computed Tomography (CT) performed in 37 patients, intra-abdominal injuries were found in 22.5% of cases, thoracic injuries in 9.9% and pelvic injuries in 2.8%. The mean number of days of hospitalization was 8.07 SD ± 7.67. In Table 2, we show the mean of the clinical and laboratory variables.

Risk factors for severity in patients with surgical trauma

Dichotomization of the variables was performed. According to the literature reviewed the predictor factors that were significant p<0.005 were: HR (Heart Rate) greater than 100; MAP (Mean Blood Pressure) less than 70; SBP (Systolic Blood Pressure) less than 90; excess base greater than -6; pH less than 7.25; PT (Prothrombin Time) greater than 14.5; bicarbonate less than 17.5 (Table 3). In addition, a mean difference was performed in the factors that were positive, which were statistically significant (p<0.005) (Table 4). A mortality rate of 5.6% was reported.

Table 1: Demografic variables.

Variables	Frequency (n)	Percentage (%)
Sex		
Female	12	16.9
Male	59	83.1
	MEAN	**SD +/-**
Age	31	15.6
Time of arrival to emergency	36.3 minutes	0.456
	Frequency (n)	**Percentage (%)**
Type of trauma		
Blunt	58	81.7
Penetrating	13	18.3
Cause		
Traffic accident	41	57.7
Fall	11	15.5
Occupational	4	5.6
Physical Aggression	15	21.2

Discussion

Injuries resulting from trauma constitute a public health priority, since they tend to occur more often in people who are in their economically active age. Their medical care costs are high due to the need for surgery and hospitalization in intensive care [1,11]. The Ministry of Public Health of Ecuador shows that death due to traffic accidents is one of the most frequent causes. It is the sixth leading cause of death in the country. It is also worth noting that 79.5% of these victims are males [12]. These data correlate with the present study since we observed that the male gender was more prevalent to suffer from these injuries. In fact, 83.1%, of participants were men with a mean age of 31 years SD ± 15.6. Secondary trauma to traffic accidents includes 41 patients representing 57.7% of the population. Their characteristics are also similar to those referred to in other studies related to multiple traumas and the vital compromise of the patient [1,13].

Polytrauma represents mortality rates that vary from 10% up to 63% if it is associated with cranial trauma and 35% if it occurs along with pelvic fractures [14]. In this study a mortality of 5.6% was found. This value is comparable with other countries such as in India where the incidence of mortality is 8% [15]. In the United States, polytrauma is the main cause of death in patients under 45 years of age [16].

Vital signs

The results of the study show a HR mean of 92.4 beats per minute SD ± 20.73, SBP (111 mmHg, SD ± 20.4) and MAP an average of 83.4 mmHg, SD ± 15.5. Öztekin Ö et al. [1] obtained data from 180 patients who donated a unit of blood (480 ml) being categorized as hemorrhagic shock type I. They found that systolic, diastolic and mean blood pressure tend to slightly decrease while HR rises to 90 beats per minute. The patient admitted with arterial hypotension and requiring laparotomy needs every 3 min this intervention otherwise it will increase mortality by 1%. The relationship between arterial hypotension and tachycardia has been observed in only 65% of compromised patients according to several studies [1,11]. Ozakin E et al. [17] (Turkey-2020) took the values of vital signs and

Table 2: Bleeding markers.

Variables	Median	SD+/-
Heart Rate (HR)	93	20.73
Systolic Blood Pressure (SBP)	111	20.4
Mean Arterial blood Pressure (MAP)	83.4	15.58
Oxygen saturation	91.14	8.073
Hemoglobin (Hb)	14.24	2.37
Hematocrit (Hto)	42.1	6.73
Platelets	255.85	77.19
Prothrombin Time (PT)	12.44	1.38
Partial Thromboplastin Time (PTT)	25.49	4.82
INR	1.03	0.11

Table 3: Risk factors for severity in patients with surgical trauma.

Variable		ICU	No ICU	OR	IC 95%	Valor p
HR	Higher than 100/min	13	13	10.25	2.84-36.96	*0.00
	Lower than 100/min	4	41			
MAP	Lower than 70 mmHg	8	7	5.96	1.72-20.62	*0.00
	Mayor a 70 mmHg	9	47			
SBP	Lower than 90 mmHg	7	7	4.7	1.34-16.41	*0.02
	Higher than 90 mmHg	10	47			
Excess base	Higher than -6 mmol/l	15	19	13.81	2.85-66.91	*0.00
	Lower than -6 mmol/l	2	35			
pH	Lower than 7.25	6	6	4.36	1.18-16.13	*0.02
	Higher than 7.25	11	48			
PT	Higher than 14.5	5	2	10.83	1.87-62.70	*0.00
	Lower than 14.5	12	52			
PTT	Higher than 33.3	3	3	3.64	0.66-20.06	0.28
	Lower than 33.3	14	51			
Hb	Lower than 10 g/dl	2	2	3.46	0.44-26.72	0.51
	Higher than 10 g/dl	15	52			
Bicarbonate (HCO3)	Lower than 17.5 mmol/l	11	14	5.23	1.63-16.81	*0.00
	Higher than 17.5 mmol/l	6	40			

*Statistical significance in relation to the risk factor. Yate's correction was used for values less than 5

Table 4: Relationship of risk factors with admission to ICU.

Risk Factors	ICU	N	Median	p-value
HCO_3	No	54	19.29	0
	Yes	17	16.06	
Excess base	No	54	-5.17	0
	Yes	17	-10.11	
HR	No	54	85.78	0
	Yes	17	113.71	
SBP	No	54	115.48	0
	Yes	17	96.76	
MBP	No	54	87.22	0
	Yes	17	71.29	
PT	No	54	12.20	0
	Yes	17	13.20	
Ph	No	54	7.36	0
	Yes	17	7.25	

*We applied t student

laboratory parameters in the initial evaluation of patients to calculate the perfusion index. They obtained averages of SBP 120 mmHg, HR 88 beats per minute, respiratory frequency in 20 breaths per minute. They argue that in this type of patients normal values do not exclude latent serious injuries.

Imaging studies

In this study we found that out of 40 patients who underwent FAST, 50% were positive. FAST has a sensitivity of 38% to 95.4% for solid organ lesions while in hollow viscera lesions its sensitivity is 38.5% but it rises to 85.2% when the study is repeated in 12 h to 24 h. The Extended FAST (E-FAST) orients its exploration to the pleural and pericardial spaces presenting a sensitivity of 69% and specificity of 99% for the detection of pneumothorax. In relation to pericardial effusion its sensitivity is 91% and its specificity is 94% [14].

Netherton et al. conducted a systematic review and meta-analysis regarding the diagnostic accuracy of E-FAST in trauma patients reporting significant results as a useful tool in the early evaluation of hemodynamically unstable patients. However, in patients with pelvic girdle involvement the diagnostic instrument is operator dependent [18].

Ordoñez et al. [19] evaluated the implementation of a new total body computed tomography protocol in patients with severe trauma. 263 patients divided into 3 groups were considered. The groups were hemodynamically stable closed trauma, hemodynamically unstable closed trauma and stable or unstable penetrating trauma. The admission time to the emergency department until obtaining the tomography was less than 30 min. There were no differences between groups with respect to survival rates. The investigators state that this protocol has made it possible to decide whether patients with severe trauma require emergent surgical interventions, thus reducing the rate of unnecessary surgeries.

The average CT time is 12 min, and it has been shown that it can identify up to 4% of injuries not suspected by the patient's clinic. 75% of these injuries are severe and lead to a change in treatment decisions by 18% [14]. In this study, a tomographic examination was performed in 37 patients of whom intra-abdominal lesions were obtained in 22.5% of cases, thoracic lesions in 9.9%, and pelvic lesions in 2.8%.

Use of blood transfusions and antifibrinolytics

We found 38% of patients in whom a blood transfusion was activated. This value is lower than that published by Pariente et al. [20] in an observational study with 184 patients who have suffered high energy trauma. They found that 41% of individuals needed a blood transfusion. A study conducted at the University of California collected data from 3,468 trauma patients over a 5-year period and concluded that a lactate value >4 mmol/L is an early predictor of the

need for blood transfusion, as well as of the volume transfused, the risk of admission to the intensive care unit and the risk of mortality [18,21].

The Task Force for Advanced Bleeding Care in Trauma recommends the use of tranexamic acid in patients with severe trauma, since it favors a decrease in mortality [9,22,23]. Morales et al. [23] performed a systematic review and meta-analysis including 20,697 patients, obtaining that the use of tranexamic acid produced a decrease in mortality (p=0.004) and recovery in the functional state of the individual (p=0.02). They also found that its application was associated with an increase in the time of hospitalization in the ICU.

Predictors of risk for admission to intensive care

Twenty-four percent of patients required admission to the ICU. Early predictors that represented a risk were HR greater than 100 (OR: 10.25 CI 2.945-35.208, p=0.00), MAP less than 70 (5.96 CI 1.34-16.41, p=0.01), SBP less than 90 (4.7 CI 1.34-16.41, p=0.01). Nagori et al. [7] conducted a multicenter study with 17,294 patients and found HR and SBP to be the most important predictors for intensive care unit stay.

Arterial blood gas parameters reported in this study expose a pH less than 7.25 representing 4 times the risk of ICU admission (OR 4.36 CI 1.18-16.13, p=0.03). In turn a patient with a base excess greater than -6 has a high risk of ICU admission (OR 13.81 CI 2.85-66.91, p=0.00). Lactate and base excess has been associated with the need for surgical intervention when dealing with penetrating trauma and base excess levels less than -6 is associated with low risk of mortality [11].

Baseline deficit is considered as an early marker and risk stratifier in the triage of trauma patients, setting as a cut-off point <-6 mmol/L for all those at risk of developing complications. Thus, it has been concluded that it is a useful tool in the early clinical and surgical management of trauma patients [24]. This supports the results obtained in the study, being the baseline deficit proportional to the risk of requiring admission to the intensive care unit.

Limitations

It was not possible to perform the analysis of lactate parameters, because not all patients had this parameter, sometimes due to lack of reagent in the hospital center.

Conclusion

The early predictors of severity in operative trauma were HR greater than 100, MAP less than 70, SBP less than 90, pH less than 7.25, base excess greater than -6, HCO_3 less than 17.5 and PT greater than 14.5.

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