International Journal of Medical Science and Clinical Research Studies

ISSN(print): 2767-8326, ISSN(online): 2767-8342

Volume 04 Issue 02 February 2024

Page No: 184-198

DOI: https://doi.org/10.47191/ijmscrs/v4-i02-06, Impact Factor: 7.949

Shock Index and Lactate Level as Prognostic Factors of 24-Hour Mortality in Polytraumatized Patients in Emergency Services

César Rodríguez García[1], Adan Pacifuentes Orozco[2], David Alejandro Rodríguez Herrera[3], Laura Yuritzi Barroso Barrera[4], José Fernando Montiel Castañeda[5], Raul Manuel Cota García[6], Inti Valle Bracamontes[7], Mariana Jimena Adame Chavez[8], Carlos Ignacio García Castañeda[9]

1(https://orcid.org/0009-0000-4961-5127) Hospital General Regional Numero 1 Charo Michoacán, Instituto Mexicano del Seguro Social.

[2](https://orcid.org/0000-0002-2839-1053) Hospital General Regional Numero 1 Charo Michoacán, Instituto Mexicano del Seguro Social.

[3](https://orcid.org/0000-0002-7238-2541) UMAE #71 Torreón, Coahuila.

[4](https://orcid.org/0009-0005-3777-5461) Hospital General Regional Núm. 2, Villacoapa, Instituto Mexicano del Seguro Social/ UNAM

[5](https://orcid.org/0000-0003-0976-216X) Hospital General de Ensenada, Secretaria de Salud del Estado de Baja California

[6](https://orcid.org/0009-0009-0895-7038) Hospital General de Ensenada, Secretaria de Salud del Estado de Baja California

[7](https://orcid.org/0000-0001-6006-133X) Centro Médico Nacional de Occidente, Instituto Mexicano del Seguro Social

[8](https://orcid.org/0009-0005-0298-946X) Hospital General Regional Numero 1 Charo Michoacán, Instituto Mexicano del Seguro Social.

[9]Centro Médico Nacional de Occidente, Instituto Mexicano del Seguro Social

ABSTRACT

Background. Patients with polytrauma have a high rate of mortality rate in emergency services, it is important to detect early the prognostic factors that may influence as predictors; they have been useful as markers of mortality; shock index and the lactate level; those that must be detected in a timely manner for their management, rule out patients with lower risk, prevent complications and thus reduce the mortality rate.

Objective. To determine the shock index and lactate level as prognostic factors for 24hrmortality in polytraumatized patients in the emergency department of the regionalhospital number 1 in Charo, Michoacán.

Material and methods. Observational, analytical, retrospective and cross-sectional study carried out in the emergency department of HGR1 Charo, Michoacán from May 2022 to April 2023. The results of the gasometric study on admission with lactate measurement were evaluated; and calculation of the shock index, clinical information was recorded, and its progression to mortality. **Results:** A total of 108 patients with a diagnosis of polytrauma were recorded, of wich 13(12%) presented mortality, demonstrating a direct relationshipbetween a shock index greater than 0.9 and lactate levels > 2mmol/lt. Of the total number of patients, 82 presented a shock index of less than 0.9, that is, 75.9%, and 26 equal to or greater than 0.9, that is, 24.1%. 65 patients presented a lactate level less than 2mmol/lt, that is, 60.2% and 43 a lactate level greater than or equal to 2mmol/lt, 39.8%. **Conclusions:** An initial index score greater than 0.9 and lactate levels > 2mmol/lt on admission of a polytrauma patient to the ED at HGR No 1 IMSS Charo, is directly associated with higher mortality independent of other biochemical and sociodemographic factors.

KEYWORDS: Shock index, lactate, mortality, polytrauma.

ARTICLE DETAILS

Published On:
06 February 2024

Available on:
https://ijmscr.org/

INTRODUCTION

Trauma is considered a global public health problem because it is one of the leading causes of death and disability (1,2,3). Trauma is defined as an "injury or cellulardisruption caused by a high-energy exchange with the environment that is greater than the body's resistance" (4).

Shock is the clinical expression of the inability to cover the metabolic needs of the cell, with a circulatory insufficiency that culminates in the inadequate utilization of oxygen, due to a decrease in its availability (5,6). This entity represents a challenge due to its great variability of lesions, ranging from single localized lesions to multiple organ failure (7)

Vital signs such as heart rate, blood pressure and respiratory rate have been used by different trauma groups to detect early abnormalities.

The shock index (CI) is a physiological outcome obtained from the ratio of heart rate to systolic blood pressure (HR / SBP), which can guide in prehospital and initial emergency care to determine the severity of trauma, and also to detect early hemorrhagic shock (2,8). On the other hand, baseline deficit has been associated with increased mortality and a higher incidence of shock-related complications (9).

MATERIAL AND METHODS

Research Design

Type of study: Observational, descriptive, cross-sectional and retrospective.

Place and time: Hospital Regional No. 1. IMSS Charo Morelia, Michoacán; May 2022 to April 2023.

Universe: Adult patients entitled to the Regional Hospital No. 1 IMSS Charo, Michoacán.

Population: Adult beneficiaries admitted to the emergency department of the Regional Hospital No. 1 of the IMSS of Charo, Michoacán with diagnoses of polytraumatized in the previously indicated period of time.

Type of sampling: Non-probabilistic.

Criteria for selection

Inclusion Criteria

- Records of patients seen in the emergency department who, upon being received, are diagnosed with polytraumatization and/or the reason for consultation.
- Both sexes over 18 years of age and under 65 years of age.
- From beneficiaries of the Mexican Social Security Institute.

Exclusion Criteria

- That upon admission they come from the emergency department of another hospital orhave previous management.
- With evidence of malignancy.
- With a history of autoimmune disease.
- Previous diagnosis of inflammatory bowel disease or other states that alter the lactatevalue (sepsis, COVID-19, etc.).
- History of structural heart disease.

Elimination criteria

- Patient records with loss to follow-up in HGR1 Duplicate orinsufficient records.

Description of the study procedure

Authorization for the research study was requested from the corresponding CLIS and CEIS committees based at the Hospital General Regional Núm. 1 Charo, Michoacán. Subsequently, a letter of no objection was requested from the director of Hospital General Regional No. 1 Charo, Michoacán.

A letter of consent and a letter of no objection was provided by the Hospital Director in order to make use of the resources available in the clinical archive to fulfill the objectives of this research (See Annexes section - Annex 1 and 2. Letter of confidentiality and letter of no objection).

Once the registration number for the research in question had been authorized and obtained, following informed consent of no inconvenience, we proceeded to analyze the files that met the inclusion criteria of the research.

A simple non-probabilistic sampling was designed based on an infinite population and patients were chosen consecutively until the total estimated sample was reached.

Eligible observation units were identified during the study period, eliminating those that did not meet the inclusion/exclusion criteria.

A preliminary list of eligible participants was made, this list in which the identification and inclusion of patients in the study was eliminated.

The criteria to be recorded during the analysis of the cases chosen based on the observer's criteria provided by the record obtained from the initial notes of the emergency department, corroborated in the institution's laboratory database and nursing records, the relevant determinations that apply to the present investigation, within whichepidemiological variables were included: age, sex, type of trauma and, clinical, diagnostic and therapeutic variables: diagnosis, type of trauma, classification/severity and therapeutic measure used.

A data collection instrument was developed based on the variables of interest to the researchers; since these were laboratory measurements, their validity is standardized in the clinical laboratory of the unit and the methodology is the same for all the records in the sample included.

Information quality control

Data entry was carried out by the student, and the researcher

Corresponding Author: César Rodríguez García

supervised randomly selected files to verify that they were properly entered.

Methodology of data collection

They were taken from the clinical record and clinical constants were recorded: systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), temperature and respiratory rate.

Clinical and analytical data were also collected at admission: 24-hour evolutionary data at the end of the present investigation: water therapy, blood product transfusions, PaCO2, PaO2 and serum lactate.

Finally, the information was entered into an Excel database for statistical analysis.

The name of the patients is not mentioned in any publication related to it. And thedatabase was stored in a removable memory (USB) which was safeguarded.

Finally, conclusions and recommendations based on the results of the study wereprovided for the degree.

Operational description of the work

Place of study

The present meeting was held at the Regional General Hospital No. 1 of Charo,Michoacán de Ocampo, telephone: 4433 22 26 00 extension 15.

Analysis statistical

Results collected from the observation units were captured in a Microsoft Office 2019 for Windows Excel electronic collection sheet (spreadsheet(s)) to develop a database.

For the descriptive statistical analysis, measures of dispersion (range, standard deviation) were used for quantitative variables, or measures of central tendency (mode, percentage), in the case of qualitative variables. The corresponding statistical analysis was performed for a sample (Chi-2 test, binomial test, Kolmogórov-Smirnov test, as appropriate) and the analysis was based on these using descriptive statistics according to the objectives of this research work. Statistical significance of the asymptotic variables was assigned according to a critical point value (p-value) of <0.05.

The analysis of the data obtained was performed using dispersion measures (mean, median, mode, range, standard deviation, etc., depending on whether the variables were parametric or nonparametric); complementing the analysis with relevant descriptive statistics in order to identify whether in the study population the shock index and lactate are related to 24-hour mortality based on frequency, percentages and temporality of the events. The research group intends to develop the evaluation of the comparative ROC with a cut-off at 24 hours after the beginning of the observation.

The statistical analysis used the IBM SPSS Statistics 29 package in its Spanish version. The presentation of the data is through tables and graphs at the discretion of theresearcher, and tools generated by means of Microsoft Office Excel 2019 for Windows were also used in order to provide the most appropriate explanation for the reader to whom this study is addressed.

THEORETICAL FRAMEWORK

Background

At the end of the 18th century, the surgeon John Hunter suggested that the biological response to an organic lesion has a beneficial objective, postulating that during trauma a response occurs that does not correspond to the damage but to compensatory mechanisms in an attempt to heal (10).

Recently, the validity of the *Advanced Trauma Life Support* (ATLS) clinicalclassification of hypovolemic shock has been questioned (9, 11), so vital signs such as heart rate, blood pressure, respiratory rate, and other biochemical markers have been used by different trauma groups to detect abnormalities related to shock and/or trauma status (2).

Several studies have used the shock index to identify states of hypovolemia (9, 12, 13), since the clinical manifestations of hypovolemia do not appear until there is a volume loss greater than 30-40% (4, 14).

Another useful biomarker in shock states is base deficit as it is present in patients in whom aerobic metabolisms are impaired and anaerobic metabolism is utilized. The termbase deficit was introduced by Ole Siggard-Andersen, it is an indicator of volume deficit; the base deficit as well as the lactate level reflect the degree of anaerobiosis. Its values allow assessing the hemodynamic status of the patient, as well as his response to treatment (13, 11).

Injuries are the most frequent cause of death in children under 45 years of age in most countries, as well as a major cause of disability, suffering and consumption of economicresources, ranking eighth in years of life lost, according to WHO statistics, with 1.3 million deaths per year due to traffic accidents (3,15, 16). Due to its diversity of presentation it represents a diagnostic challenge for the clinician (3).

After trauma, the primary injury is volume loss with a deficient oxygen supply leadingto the utilization of anaerobic metabolism; multiple organ failure may follow.

Shock is the clinical expression of the inability to meet the metabolic needs of the cell, with circulatory failure culminating in the inadequate utilization of oxygen, due to a decrease in its availability (6, 17). Immediate identification of the cause and hemodynamic support of the patient in shock is crucial to prevent worsening of the condition (6, 18).

Hypovolemic shock is due to reduced intravascular volume (i.e., reduced preload), which, in turn, reduces blood supply. Hypovolemic shock can be divided into two categories: hemorrhagic and nonhemorrhagic (17).

The current ATLS system was designed to standardize the initial management of severely injured trauma patients and became the unofficial gold standard worldwide. A key aspect of initial management is the early recognition and treatment of hypovolemic shock (21). For the purposes of the present investigation we will then proceed to describe pathophysiologically the body's response to trauma, classification andidentification.

Metabolic response to trauma

The effect of trauma on the organism is, among other factors, a metabolic stress, which triggers an initial response aimed at preserving the body's metabolism energy on vital organs, modulate the immune system and delay anabolism.

The response to stress generated in trauma patients can be broadly divided into 2 phases of response, acute and chronic. In the acute response phase an immediate response to trauma occurs, which is considered appropriate and adapted, through the intervention of the neuroendocrine system. In the chronic response phase, an endocrine response to prolonged critical situations develops, which is called maladaptive and generates asystemic wasting syndrome.

The current trend and best approach to the metabolic response to trauma is one t h a t considers the hemodynamic status of the patient and the systemic consequences involved. These phases are known as the Ebb phase, Flow phase, and anabolic phase.

The physiology of the organism *per se*, is complex due to the various interactions that occur between the nervous and endocrine systems, so that by subjecting it to a series of events of aggression usually increases the degree of complexity of the same, hence the understanding of the various biochemical processes triggered.

The defined primary factors that trigger neuroendocrine responses to injury are hypovolemia and pain, reflected as changes in effective circulating volume, stimulation of chemoreceptors, triggering of pain and emotions, alterations in blood substrates, changes in body temperature and finally infection over the injured site (10).

Attempting to provide a description of the events that are triggered by a compensatory metabolic and neuroendocrine response, we found in the literature review that it involves 3 axes: 1) Neuroimmunological Axis: activation of inflammatory cells, inflammatory mediators, arachidonic acid products and neurotransmitters; resulting in a systemic inflammatory response; 2) Autonomic - Adrenal Axis: release of catecholamines, which results in increased gluconeogenesis and vascular resistances; 3) Hypothalamic - Pituitary Axis: increased secretion of ACTH, ADH and Cortisol. The increase in cortisol favors the actions of glucagon and adrenaline, favors insulin resistance, causing hyperglycemia (18).

For the purposes of this study, we will describe the changes that occur after an injury of traumatic origin, where the most prevalent cause is hemorrhagic, where the patient's evaluation, hemodynamic response supports the patient's initial ability to survive, response to treatment, subsequent morbidity and resolution (19).

Metabolic effects of hemorrhagic shock

The consequent cellular hypoxia leads to anaerobic metabolism, resulting in increased lactic acid production leading to metabolic acidosis and reduced adenosine triphosphate production. ATP depletion reduces the substrate for energy-dependent metabolic processes and results in cell membrane dysfunction.

Cardiovascular effects of hemorrhagic shock

The loss of circulatory volume due to trauma causes a decrease in venous return, with subsequent activation of baroreceptors which respond by increasing the heart rate, which adds to the increase in peripheral resistances to maintain adequate cardiac output.When volume loss exceeds 30%, the baroreceptor reflex cannot maintain arterial pressure, and a decrease in resistance and heart rate occurs, although it is thought that this mechanism increases diastolic volume and improves coronary perfusion (18,19).

Renal and intestinal effects of hemorrhagic shock.

Vasoconstriction can lead to reduced blood flow and poor oxygen delivery to vital organs such as the intestine and kidney, leading to multiple organ dysfunction (19).

Renal vasoconstriction during hypovolemia activates the renin-angiotensin-aldosterone system to maintain adequate renal perfusion, retaining sodium and water, manifesting clinically as oliguria; prolonged hypoperfusion culminates in acute renal failure. Intestinal effects due to hypoperfusion cause ileus and gastric distension, intestinalischemia may occur, due to the proinflammatory response producing microthrombi or due to prolonged hypoperfusion (18).

Initial assessment of trauma in adults

Trauma is regularly encountered in the emergency department. A polytraumatized patient is defined as a patient who presents injuries as a result of trauma involving twoor more organs, or who presents at least one life-threatening injury; while injuries can range from isolated extremities, wounds, or complex injuries involving multiple organ systems, all trauma patients require a systematic approach to management in order to maximize outcomes and reduce the risk of injury.

Patients with traumatic injuries have a significantly lower probability of mortality or morbidity (10.4 vs. 13.8%) when treated in a trauma center (21). The timing of mortality has been classically defined around concepts such as the "golden hour" and "trimodal distribution" (22, 23).

Quarterly distribution. Mortality in trauma is presented in three points: in relation to the trauma, severity and type of injuries:

- First minutes, presenting immediately after the trauma: injuries to the heart and great vessels, cranioencephalic trauma, high spinal cord injuries.

- First hours of the trauma corresponds t o : hypovolemia, subdural hematoma and hypoxia, corresponds to 30% of mortality.
- First days or weeks after trauma: multiple organ failure, sepsis. 20% mortality.

A clear, simple, and organized approach is needed in the management of a critically injured patient. The primary assessment promulgated in *Advanced Trauma Life Support.* The primary assessment is organized according to the injuries that represent the most immediate threats to life (25).
The primary evaluation consists of the following steps:

- Evaluation of airway and cervical spine protection.
- Breathing and ventilation assessment.
- Circulation Evaluation.
- Neurological evaluation.
- Exposure, with environmental control.

The following point should be kept in mind while performing the primary assessment: *"Hemorrhage is the most common preventable cause of mortality in trauma."* Hypovolemia can be classified according to circulatory volume loss into:

- Grade I: when there is a volume loss of less than 15%.
- Grade II when volume loss is 10 to 30%.
- Grade III when the volume deficit is 30-40 %.
- Grade IV: volume deficit of more than 40% (21, 24, 25).

The current *Advanced Trauma Life Support* system was designed to standardize the initial management of severely injured trauma patients and became the unofficial gold standard worldwide (21, 24), however, the validity of the clinical classification of hypovolemic shock has been questioned (9, 11).

In trauma patients, a systemic hemodynamic assessment should be performed, since the body triggers a neuroendocrine and metabolic response in response to trauma (6).
Delayed treatment of hypovolemic shock has been associated with adverse outcomes, including increased organ dysfunction and mortality. Therefore, for each class of shock, ATLS recommends a specific intervention to mitigate the presumed level ofhemorrhage. However, several studies have shown that the ATLS classification may notaccurately reflect the degree of hemorrhage (20).

Shock index

The normal ratio of HR to SBP is generally <0.7. This ratio is elevated in the setting of acute hypovolemia and circulatory failure and is known as the shock index (27).
Shock index (CI), defined as the ratio of heart rate (HR) divided by systolic blood pressure (SBP) (13, 28, 29), was first presented by Allgöwer and Burri in 1967 and in healthy adults ranges from 0.5 to 0.7 (30, 8).
An increase in HF means decreased left ventricular output and acute circulatory failure. Persistent increases in HF are associated with increased mortality (8, 13, 27).
It is an early indicator of hypovolemia and could be an early marker of sepsis and septic shock (6). The Shock Index has been suggested as a useful clinical indicator for acute hypovolemia, especially in patients presenting with HR and SBP within normal ranges (11), making it a widely used tool that identifies acutely ill patients at risk of circulatory collapse in the emergency department (31). One of the advantages of using the shock index is that it is a minimally invasive monitoring (6, 7, 33).
Since this index could be useful in predicting the severity of hypovolemic shock, (8) recently, a group (*The Trauma Register TGU* of the German Trauma Society) has developed a new reliable clinical classification of hypovolemic shock based on four classes of worsening shock index (CI):

- Group I (CI <0.6, without shock)
- Group II (CI ≥0.6 to <1.0, mild shock)
- Group III (CI ≥1.0 to <1.4, moderate shock)
- Group IV (CI ≥1.4, severe shock) (11)

Serum lactate

For more than 30 years lactate has been recognized as a marker of hypoperfusion and inadequate oxygen delivery to tissues; there is a resurgence of lactate today thanks to technological advances that allow serum samples to be analyzed in less than 2 minutes with a faster clinical interpretation, an automatic blood gas test and arterial blood sampling, which could be considered invasive and costly in patients with normal vital signs (34).
Serum lactate has value as a marker in states of shock, where the failure of oxygen delivery to the tissues produces a compensatory mechanism that increases the rate of oxygen extraction, which is only useful if accompanied by an adequate minimum of oxygen to avoid anaerobic metabolism and lactate production (35).
It has been further identified that the decrease in lactate is a surrogate marker for adequate tissue perfusion after ROSC and potentially serves as an end point for resuscitation (36).
In recent years, the potential value of lactate on admission for predicting survival has been studied. However, the variable results of such studies mean that it is still difficultto make definitive decisions (37), mainly because the evidence generated is of low level and based mainly on small retrospective studies, determining that larger and better controlled studies are needed to assess the value of lactate as a prognostic marker in the trauma patient (38).

RESULTS

A total of 108 patients were analyzed who were admitted to the emergency department of HGR No 1 IMSS, Charo, with a diagnosis of polytrauma, of which 60 were men (55.6%) and 48 were women (44.4%) (Figure 1), in the period from May 2022 to April 2023; obtaining from them on their admission a record in the unit's laboratory of serum lactate levels, as well as vital signs (SBP and HR) that would allow us to determine the shock index.

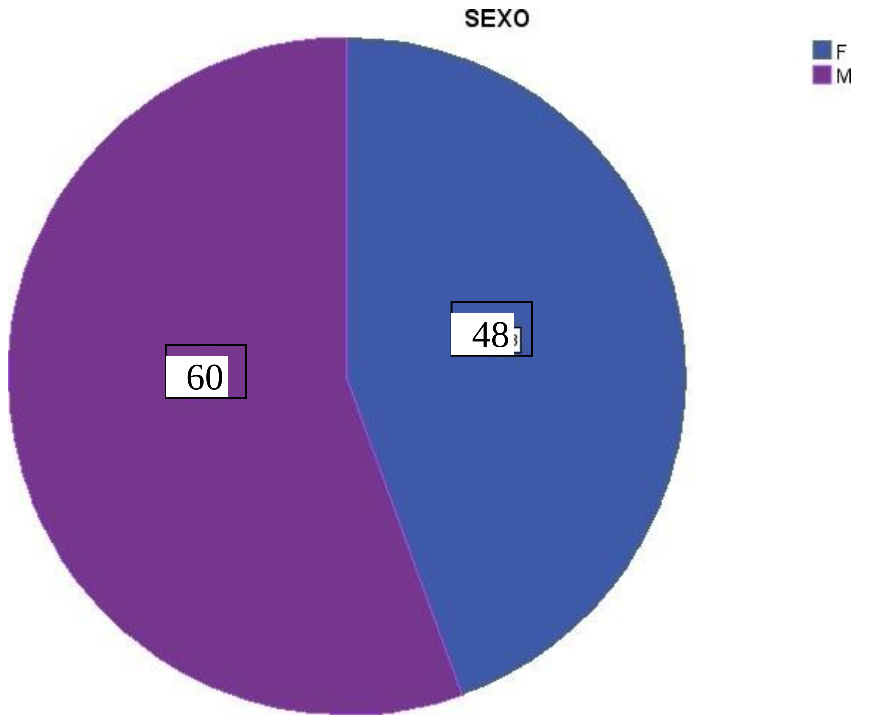


Figure 1. Gender of patients with polytrauma of HGR No 1 Charo, Michoacán from May 2022 to April 2023.

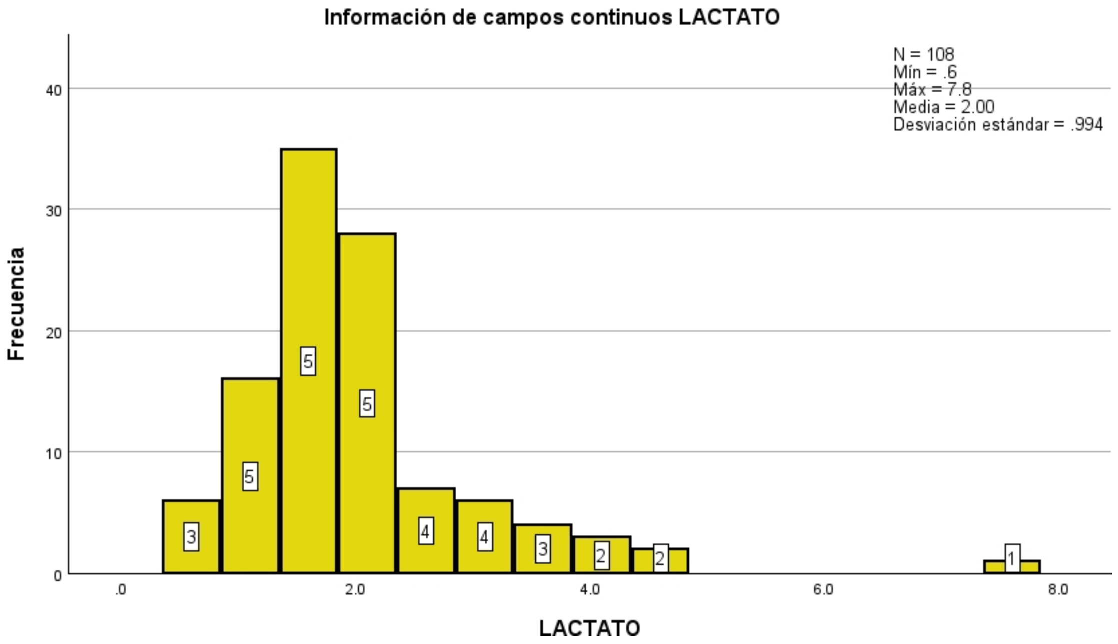
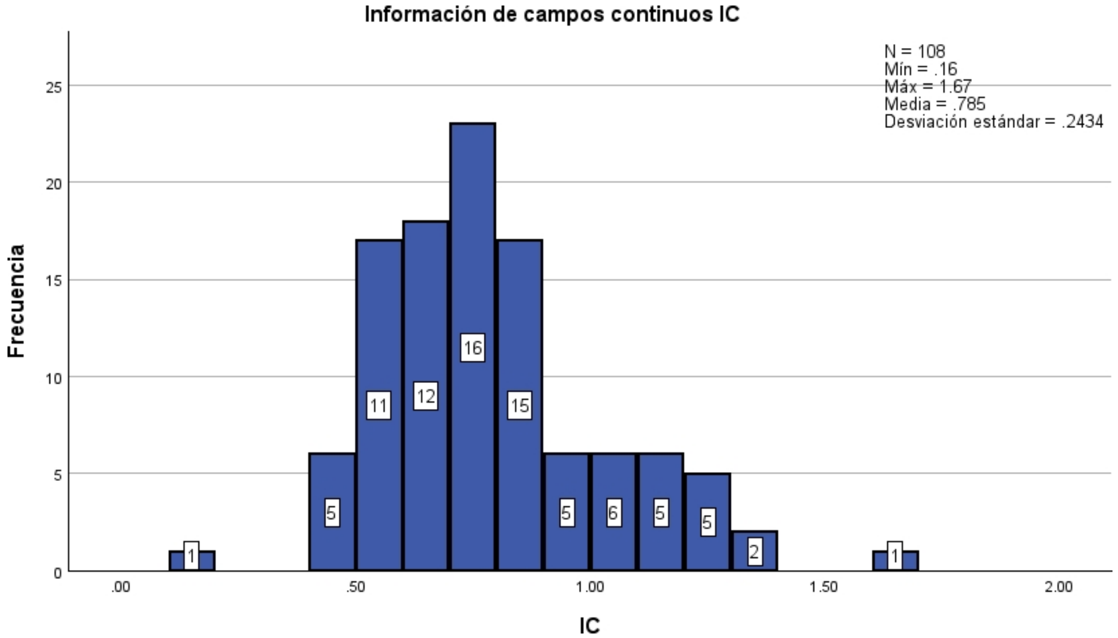


Figure 2. shows the ranges of lactate level at patient admission.

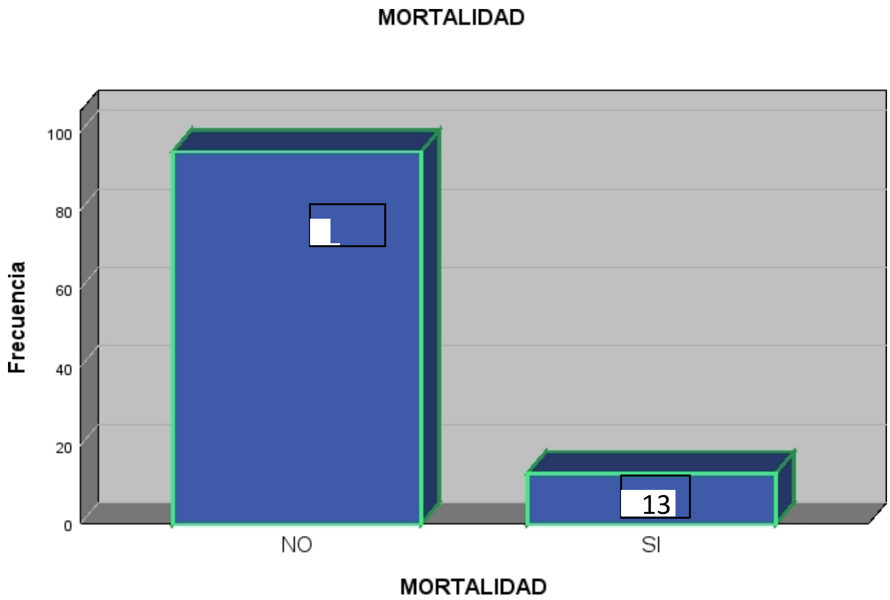
The ages of patients who presented with a diagnosis of polytrauma in HGR No 1 Charo,in the period from May 2022 to April 2023 were from 18 to 65 years with a mean of 44 years, and a standard deviation for patients who presented with mortality of 51 yearsand those who presented with survival of 43 years.

Lactate levels in polytrauma patients admitted to the ED of HGR No 1 Charo in theperiod from May 2022 to April 2023.

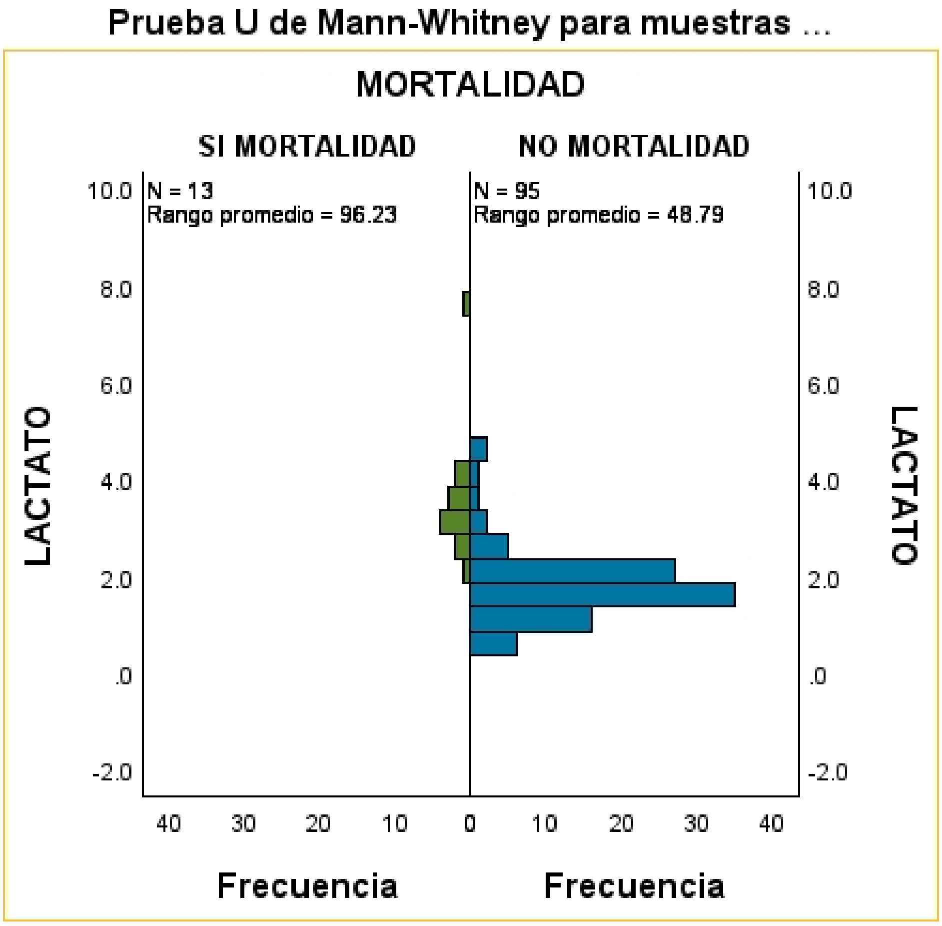


Levels of shock index in patients with polytrauma admitted to the ED of HGR No 1Charo in the period from May 2022 to April 2023.

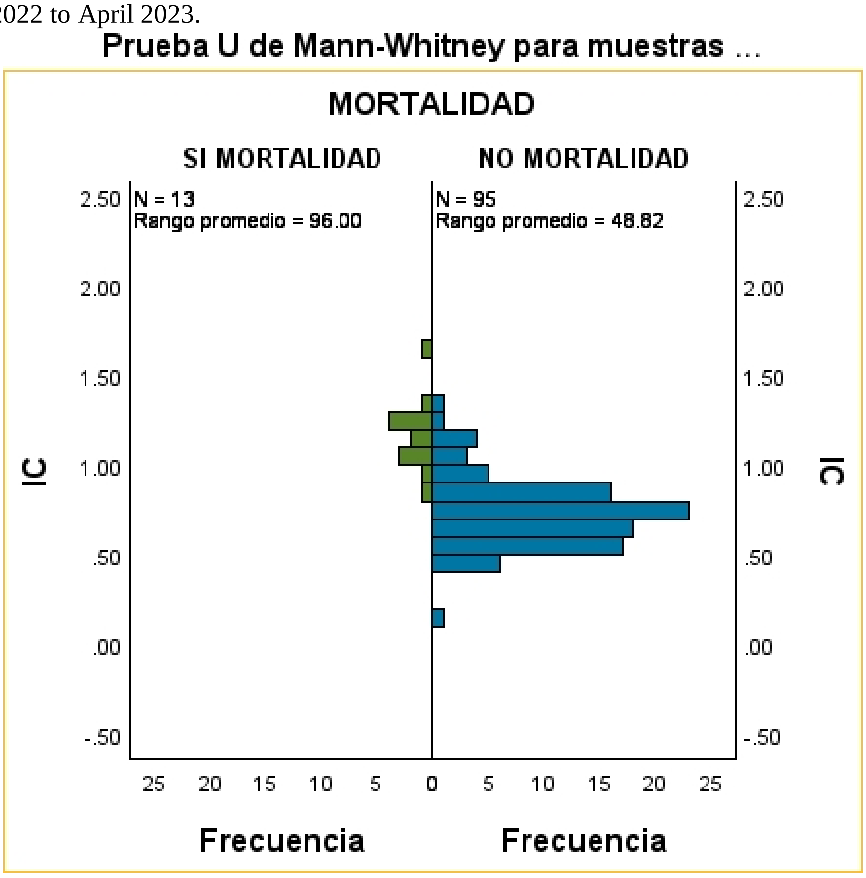
Figure 4 shows the total mortality of the patients studied with a diagnosis of polytraumain the ED of HGR No. 1, which out of 108 were 13 regardless of the variables included in the study.



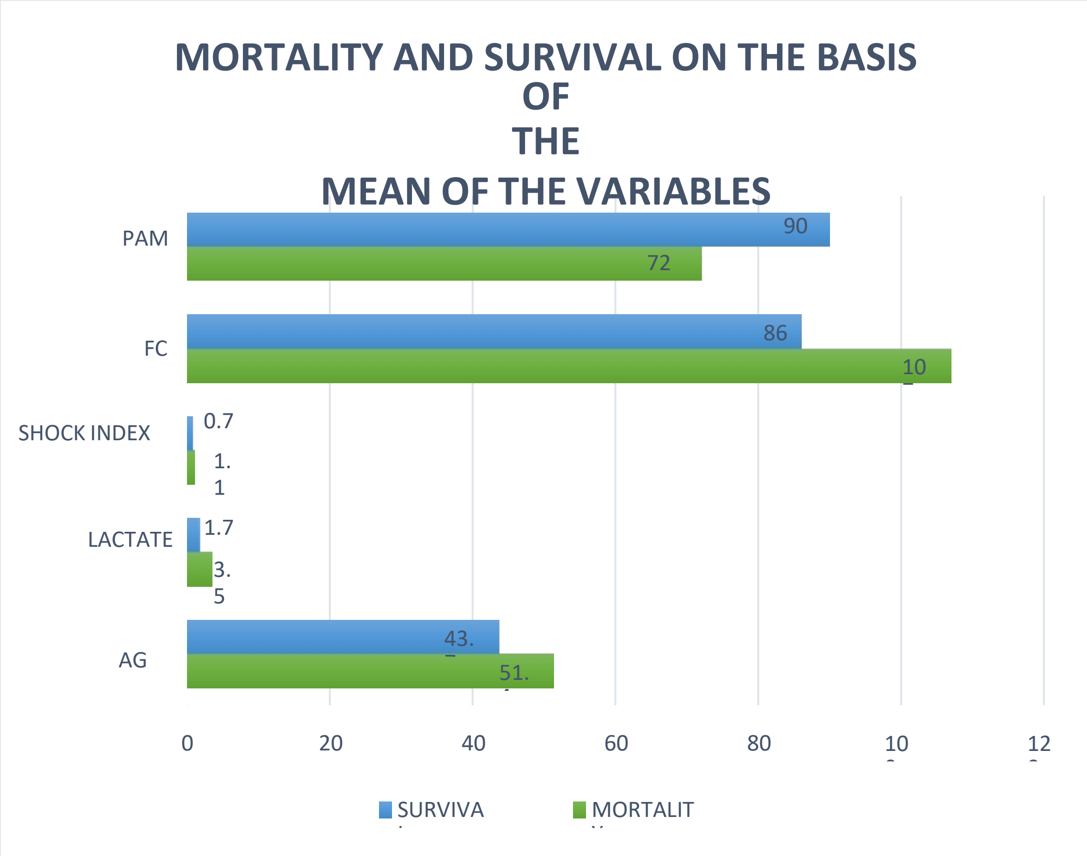
Mortality of patients with a diagnosis of polytrauma admitted to the ED of HGR No 1 Charo in the period from May 2022 to April 2023.

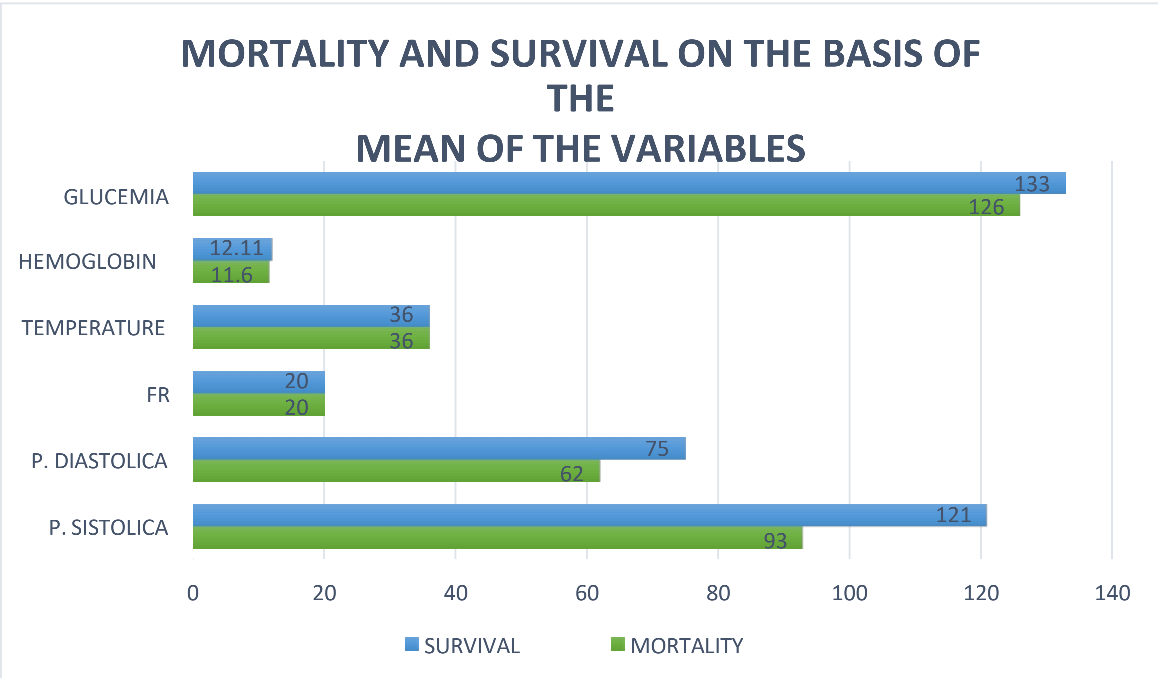


Mortality of patients with respect to lactate levels in patients with a diagnosis ofpolytrauma admitted to the ED of HGR No 1 Charo in the period from May 2022 to April 2023.



Mortality of patients with respect to the levels of the shock index in patients with a diagnosis of polytrauma admitted to the ED of HGR No. 1 Charo in t h e period from May 2022 to April 2023.





Frequency of patients with mortality and survival according to the mean of the variablesindicated in the population with a diagnosis of polytrauma in the ED of HGR No 1 Charo in the period from May 2022 to April 2023.

Table 1 shows comparative data between patients who died and those who survived, showing that according to age, those who died averaged 51 years of age and those who survived averaged 51 years of age.

A comparison was made between the means of clinical data such as the shock index, showing that the higher the shock index (1.16 vs. 0.73), the more patients died; concluding that there is a relationship between the highest lactate level and mortality; with a mean lactate level of 3.52mmol/lt, versus 1.79mmol/lt, in persons who died versus those who survived.

Likewise, patients who died had a mean SBP of 93 versus 121mmHg in those who survived, as well as DBP of 62 versus 75mmHg and MAP of72 versus 90mmHg. It should be noted that the differences between the groups were significant.

Table I. Statistical representation of mortality and survival, significant variables in thestudy group from May 2022 to April 2023 of HGR No 1, IMSS Charo.

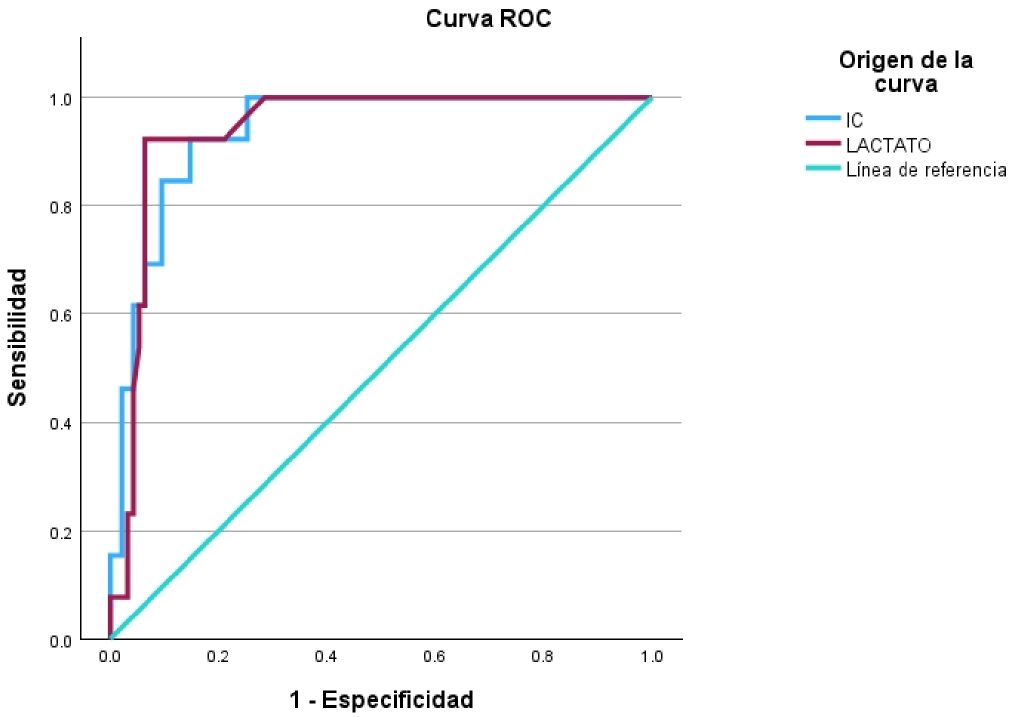
VARIABLE	MORTALITY (N 13) MEAN ± OF	SURVIVAL N (95)MEAN ± SD	P
AGE	51.4 ±14.34	43.74(15.39)	0.48
LACTATE	3.52±1.89	1.79(0.71)	< 0.001*
SISTOLIC	93.77±13.06	121.36(20.49)	< 0.001*
DIASTOLIC	62.46±13.31	75.8(14.22)	< 0.001*
CR	107.8±14.38	86.51(17.33)	< 0.001*
RR	20.85±4.86	20.82(2.39)	0.48
TEMPERATURE	36.42±0.42	36.65(0.62)	0.1
PaO2	101.15±55.49	108.34(43.79)	0.29
PaCO2	31.85±6.33	34.61(6.64	0.08
HEMOGLOBIN	11.68±1.59	(1.82)12.11	0.21
GLICEMIA	126.85±45.43	133.41(37.77)	0.28
MAP	72.9±12.82	90.99(14.96)	< 0.001*
CI	1.16±0.21	0.73(0.19)	< 0.001*
HOURS OF STAY	27.69±29.86	16.75(14.85)	0.017*
FEMALE (%)	4(8.3%)	44(91.7%)	0.37
MALE (%)	9(15%)	51(85%)	0.37
CONTROL ELECTROLITI CO N (%)	10 (76.9%)	81(85.3%)	0.47

- *Statistically significant figure (P < 0.05) Resultsexpressed as mean* ± standard deviation

Student's t test for independent variables for normal distributions and Mann-Whitney Utest for distributions that did not meet the assumption of normality.

IC shock index, HR heart rate, RF respiratory rate.

 Corresponding Author: César Rodríguez García



Comparison of ROC curves showing an area of 0.939 for the lactate curve and 0.937 forthe shock index curve, which are considered a very good test since they are in the range 0.9-0.97, with an AUC of 0.90.

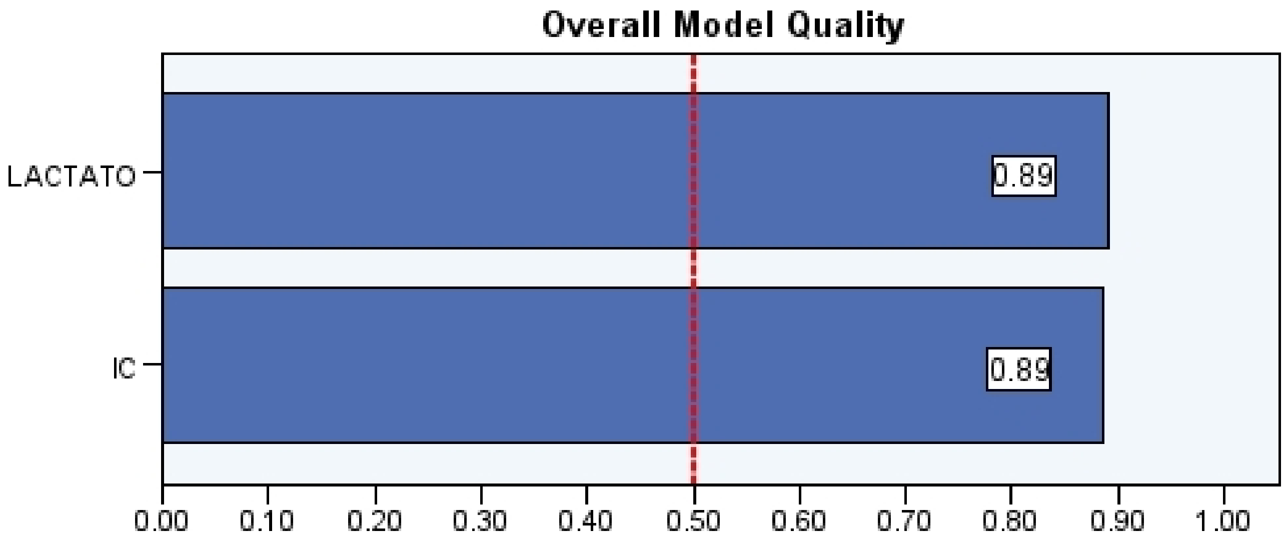


Figure 9. Reports the diagnostic yield of the tests finding an area under the curve with adequate yield for both lactate and shock index; a good model has a value greater than 0.5.

Tabla cruzada INDICE DE CHOQUE*MORTALIDAD

			MORTALIDAD		
			SI MORTALIDAD	NO MORTALIDAD	Total
INDICE DE CHOQUE	CLASE I	Frecuencia	0	42	42
		% del total	-3.1	3.1	
	CLASE II	Frecuencia	2	44	46
		% del total	-2.1	2.1	
	CLASE III	Frecuencia	10	9	19
		% del total	6.0	-6.0	
	CLASE IV	Frecuencia	1	0	1
		% del total	2.7	-2.7	
Total		Frecuencia	13	95	108

Table. 2 Statistical representation of mortality and survival, with respect to the frequency of shock index class in the study group from May 2022 to April 2023 of HGRNo 1, IMSS Charo

Pruebas de chi-cuadrado

	Valor	gl	Significación asintótica (bilateral)
Chi-cuadrado de Pearson	45.195[a]	3	<.001
Razón de verosimilitud	36.674	3	<.001
N de casos válidos	108		

a. 3 casillas (37.5%) han esperado un recuento menor que 5. El recuento mínimo esperado es .12.

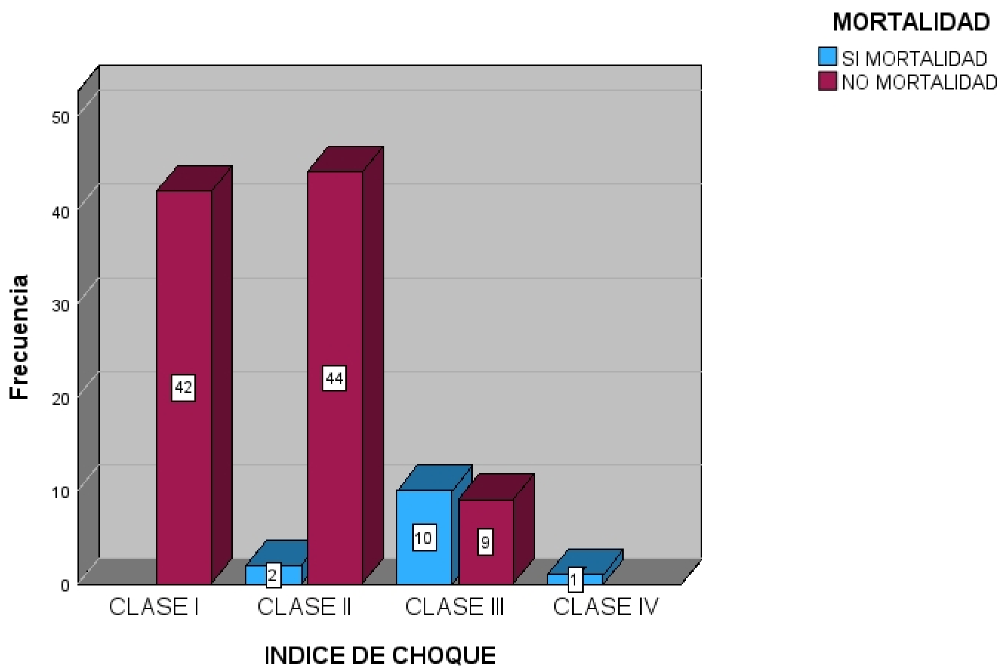


Figure. Frequency of shock class that discriminates mortality and survival, according tothe shock index calculated in patients with polytrauma admitted to the ED of HGR No.1 Charo in the period from May 2022 to April 2023.

DISCUSSION

In the study of shock and lactate index as a prognostic factor for mortality in patients with polytrauma admitted to the ED of HGR No. 1, IMSS Charo; of the 108 patients in this study 82 had a shock index of less than 0.9, that is 75.9%, and 26 equal or greater than 0.9, that is 24.1%. Likewise, 65 patients presented a lactate level lower than2mmol/Lt or 60.2% and 43 presented a lactate level higher or equal to 2mmol/Lt or 39.8%, 12% presented mortality. In addition, it was observed that the initial lactate levels presented significant differences between mortality and survival; and patientswith an initial lactate level > 2mmol/Lt showed a higher mortality, which is mentioned in the results of previous studies although there are studies that mention figures above 3.5mmol/Lt; such as Jansen et al. who suggest that lactate above 3.5 mmol/Lt is associated with higher mortality when compared to lactate levels below 3.5 mmol/Lt in polytraumatized patients at the time of hospital admission.(36).

Regarding the shock index, a study carried out in a university hospital in Colombia by Charry J, and collaborators mentioned the shock index as a prognostic factor for mortality in patients with penetrating chest trauma where 170 patients were analyzed. 75.9% presented a shock index lower than 0.9 (group A) and 24.1%, higher than 0.9 (group B); mortality at 24 hours after the injury was 13.2% for those in group A, and in group B, 60.9%. (1) In comparison with the results of our study carried out in our environment, the same relationship with a higher incidence of mortality is demonstrated in patients admitted to the emergency department with a diagnosis of polytrauma and a shock index greater than 0.9 on admission, which implies a worse prognosis at 24 hours after the injury.

Trauma continues to be a public health problem for the world population that, accordingto international protocols for the management of trauma patients, such as the Advanced Trauma Life Support (ATLS) course, which requires little or no resources in the hospital setting and in initial emergency care, would not be limited in developingcountries such as ours.

As studies of these characteristics are carried out, favorable results can be observed to identify the serious patient from the Triage in the emergency services; based on this study among many others, it is observed that the male sex is a risk factor for suffering some type of trauma since a higher prevalence is observed, being 55.6% men and 44.4%women.

Another marker or predictor of mortality that is important is lactate which is mentioned in multiple studies that correlates with the presence of a shock index greater than 0.9, which the aim of this study is to have the knowledge that a shock index greater than 0.9,

i.e. class II hypovolemic shock, can be a prognostic factor for mortality at 24 hours.9,

i.e. class II hypovolemic shock, can be a prognostic factor for mortality at 24 hours, together with a lactate greater than 2.2 mmol/Lt, in our institution a statistically significant figure was observed tied for the shock and lactate index (p=0.001). The normal lactate value is between 0.5 to 2.2mmol/Lt, when a critically ill patient reaches twice the normal maximum value i.e. 4.4mmol/Lt the probability of death is higher. Different publications support the objective of the present study, so so far we consider both the shock index and the initial lactate value that have a useful relationship in daily practice and determine the usefulness of lactate as a marker of tissue hypoperfusion and are statistically significant as predictors of mortality in patients with a diagnosis of polytrauma admitted to the emergency department of the HGR No 1 IMSS, Charo.

CONCLUSIONS

In conclusion, through this study conducted at the Hospital General Regional No 1 IMSS, Charo, it was determined that the shock index and lactate level are prognostic factors or predictors of mortality in patients admitted with a diagnosis of polytrauma; regardless of the different variables that were considered in this study, when theypresent a lactate level greater than 2.0mmol/Lt and a shock index greater than 0, they have a direct impact on the incidence of mortality.9 have a direct impact on the incidence of mortality; in addition to this we mention that the shock index is a mathematical calculation that can be used quickly and easily without requiring a financial resource in all trauma patients at risk of hypovolemic shock; hence the importance of making a timely clinical diagnosis associated with early lactate measurement and early calculation of the shock index; in order to prevent the progression of possible complications of trauma patients and thus reduce the incidence of mortality in the HGR No 1 IMSS, Charo, Michoacan.

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Appendix

Population and study universe

The universe of the present study comprised all adult patients attending the emergency department of the Hospital Regional Número 1 de Charo, Michoacán of the Instituto Mexicano del Seguro Social, during the period from May 2022 to April 2023.

Those patients were selected from the universe who were admitted during the observation period with the diagnosis of polytraumatized, in whom vital signs were taken on admission and the shock index was determined, laboratory studies were collected and the lactate level was determined, and who had complete records useful for observation and analysis, in order to avoid selection and observation biases.

Sample size calculation

For the calculation of the sample size, the proportional sampling formula with infinite population is used, considering a value α=0.05, based on the findings observed by Raja et al (21), where mortality due to trauma is 13%, with a confidence level of 95% and a margin of error of 10% through the following formula:

$$n = \frac{(Z\alpha)^2 (p)(q)}{d^2}$$

Where:

$Z\alpha$ = is the corresponding z-value α to obtain a 95% CI.

p = is the proportion is 13%.

q = is the value obtained from 1-p

d = is the desired accuracy in this case is 6.5%.

$n=[(1.96)^2 (0.13)(0.87)]/(0.065)^2$ = $n=[3.8416 (0.1131)]/0.004225$ $n=0.4344/0.004225$
n=102.81

In addition, the value of "n" (the sample size) (108) will be increased by 10%, to take into account the replacement of surveys that have not been completely answered by applying 91 measurements for analysis. In doing so, we ensured that the selection had sufficient statistical power (<90%). It was carried out non-probabilistically by selection of consecutive cases.