
Qualification: Lactic Acid as a Prognostic Tool in the Patient with Severe Trauma

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Abstract: *Introduction:* The severe polytraumatized patient is defined as that individual who presents two or more severe traumatic injuries, whether peripheral or visceral, which lead to respiratory or circulatory repercussions and put life at risk. Acidosis, hypothermia and coagulopathy called the "deadly triad" develops as a consequence of the metabolic changes induced by polytraumatism, are difficult to assess, diagnose and treat, since they present a high vital risk, for which reason requires rapid, complex and multidisciplinary diagnosis and treatment; through consecutive and ordered steps, based on the condition of each one of them. The persistent elevation of lactic acid levels has proven to be a useful marker to establish the incidence of mortality in certain entities. *Objective:* To determine the prognostic value of lactic acid in patients with severe trauma. *Methods:* Descriptive, longitudinal, prospective study during the period between January 2018 and December 2020, with a universe of 21 patients, theoretical and empirical methods were applied. As main *Results:* There was a predominance of the male sex in 71.4% in the ages between 21 and 40 years, 42.9% had a moderate behavior in relation to hyperlactacidemia, the complications and the state at discharge were evidenced. in a positively proportional way, not so the base excess and the stay. *Conclusions:* LA is a prognostic biochemical marker to be taken into account in the evolution of polytraumatized patients.

Keywords: Polytraumatized Patient, Lactic Acid, Hyperlactatemia

1. Introduction

Currently seven of the ten leading causes of death are non-communicable diseases, according to the WHO World Health Statistics 2019. In the last two decades, there has been an upward trend in morbidity and mortality from trauma. Its increase has been recorded due to transit in the African Region since 2000, with increasing of almost 50% in the number of deaths and in the years of healthy life lost. Similar but slightly lower figures (around 40%) were also observed in the Eastern Mediterranean region [1]. Globally, deaths due to road traffic injuries correspond to men in 75% of cases. In Cuba, traumatic injuries occupy the fifth place among the global causes of death, being also responsible for a high number of disabilities that arise as sequelae of a traumatic event. Deaths from injuries caused by road traffic and, in particular, from traffic accidents represent a silent epidemic

in the world, It affects all sectors of society. The severe polytraumatized patient is defined as that individual who presents two or more severe traumatic injuries, whether peripheral or visceral, that lead to respiratory or circulatory repercussions and put life at risk. Acidosis, hypothermia, and coagulopathy, termed the "death triad," develop as a consequence of the metabolic changes induced by polytrauma [2, 3]. It is the first hours, which are described as vital, the risk of secondary injury expressed by hypoperfusion and hypovolemia, which results in an inadequate delivery of oxygen to the tissues, which leads to anaerobic metabolism and whose final product will be lactic acid (LA). In the intensive care unit of the Faustino Pérez Provincial Surgical Hospital in Matanzas, a large number of patients with severe trauma are received, to whom therapeutic actions are applied from the beginning and throughout their evolution; It has been detected by medical personnel that patients with elevated lactic acid at the

beginning are the most prone to complications and even death. The authors focus on the study and argumentation of the fundamental theoretical bases of the polytraumatized patient, an exhaustive search was carried out, despite that, in the current and systematic reviews on the importance of the dosage of the Lactic acid in severe trauma in international and national literature there is not enough evidence. The importance attached to this research lies in the contribution to the field of science, which will allow modifying the current action protocols with a view to improving the quality of care provided to these patients, which would bring an improvement in morbidity and mortality due to trauma. Overall Objective: Determine the value of lactic acid in patients with severe trauma.

2. Methods

A descriptive, longitudinal, prospective study was carried out during the period between January 2018 and December 2020. Universe: It consisted of 21 patients who were admitted to the intensive care unit of the Faustino Pérez Provincial Teaching Clinical Surgical Hospital in Matanzas and who met the the following inclusion criteria. Patients with a diagnosis of severe trauma over 18 years of age who were dosed with lactic acid (LA) in the following time guidelines: on admission, at 6 hours (h), 12h, 24h, 48h after, and on discharge from unit. Exit criteria: Patients with a

diagnosis of severe trauma who were admitted to the service with mortality within 24 hours of reception. Those who did not comply with the dosage guidelines established by the researchers. Methods used: Dialectical Method, Theoretical Methods: Literature Review, Document Analysis, Analysis-Synthesis Method, Deductive Method, Transit from the Abstract to the Concrete and Modeling within the Empirical Methods: Observation and as Statistical Methods. Descriptive statistics were applied. with the Chi square method that allowed validating the importance of the use of lactic acid as a biochemical prognostic marker in severe trauma. The information was organized using tables of distribution of frequencies and percentages.

3. Results

This table showed that of a total of 21 patients with severe trauma, who complied with the follow-up guidelines for the predetermined lactic acid values for the study, 15 were male, which represents 71.4% of the total; of which 28.6% were between the ages of 21 and 40, followed by 23.8% between 41 and 60 years of age and 19% over 60 years of age. On the other hand, 28.6% of the total patients were female, and of these, 19% presented between the ages of 21 and 40, followed by 4.8% from 41 to 60 years and over 60. years.

Table 1. Sociodemographic characteristics of patients with severe trauma with lactic acid follow-up in the ICU of the Faustino Pérez Provincial Teaching Clinical Surgical Hospital in Matanzas, between January 2018 and December 2020.

ages	F-sex		Sex M		Total	
	#	%	#	%	#	%
21-40 years	4	19.0%	6	28.6%	10	47.6%
From 41 to 60 years	1	4.8%	5	23.8%	6	28.6%
Over 60 years	1	4.8%	4	19.0%	5	23.8%
Total	6	28.6%	fifteen	71.4%	twenty-one	100%

Source: Collection forms

Of the 21 patients treated, 10 of them had a single trauma located in an anatomical region, which represents 47.6% of the total universe. The remaining 11 patients had a combination of traumas, which represented 52.4% of the total, with more than

one affected anatomical region. Of this, there was a predominance of head trauma in 47.6%, followed by abdominal trauma in 42.9%, chest trauma in 38.1%, maxillofacial trauma in 28.6%, spinal cord trauma and members by 9.5% respectively.

Table 2. Distribution of patients according to the evolution of lactic acid in established time patterns.

Classify -tion according to lactic acid level	Lactic Acid Sampling Time Guidelines											
	Income		6 hours		12 hours		24 hours		48 hours		ICU discharge	
	#	%	#	%	#	%	#	%	#	%	#	%
Normal (< 2mmol/L)	5	23.8%	10	47.6%	10	47.6%	13	61.9%	17	81.0%	19	90.5%
Hyperlactation mild mild (2-4mmol/L)	6	28.6%	1	4.8%	4	19.0%	6	28.6%	2	9.5%	0	0.0%
Hyperlactation demia mode rada (4.1-8mmol/L)	9	42.9%	8	38.1%	6	28.6%	2	9.5%	1	4.8%	1	4.8%
Hyperlactation Demia Severa (>8mmol/L)	1	4.4%	2	9.5%	1	4.8%	0	0.0%	1	4.8%	1	4.8%

It was evidenced that on admission to the ICU nine patients, which represents 42.9%, had moderate hyperlactatemia, followed by six patients (28.6%) with mild hyperlactatemia, five patients (23.8%) with acid levels normal lactic acid and only one patient (4.4%) with severe hyperlactatemia. Of the same, 10 patients (47.6%) presented

a normal lactic acid level after six hours, maintaining it at 12 hours and rising from 24 hours to 61.9% progressively, at the time of discharge from the hospital. unit 90.5% (19 patients) with normal lactic acid levels; It is evident that the number of patients with mild and moderate hyperlactatemia gradually decreased. This showed that on admission the highest

percentage of the total cases presented moderate hyperlactatemia. On the other hand, from the first hours of reception in the ICU, normal lactic acid levels already predominated, at 24 hours the clearance was towards normal in more than 30% (38.1%), reaching 66.7 % at the time of discharge from the unit.

A predominance of normal lactic acid was defined as patients who during their evolution in the unit had a predominance of normal lactic acid levels; moderate hyperlactacidemia in patients who during their evolution in the ward had a predominance of lactic acid levels between 4 and 8 mmol/L; and severe hyperlactatemia to patients in whom lactic acid levels greater than 8 mmol/L prevailed during their stay. In patients with a predominance of normal lactic acid levels during their evolution in the service, it was observed that 45.5% presented between one and five

complications; In addition, 27.3% had no complications, although an equal percentage developed between six and 10 complications. Of the patients in whom moderate hyperlactacidemia predominated during their evolution, 57.1% of the cases presented between one and five complications. The severe predominance does not depend on the number of complications with the severity of hyperlactatemia. Among the complications developed, metabolic acidosis-type acid-base imbalance predominated in 52.4% of all patients, followed by pneumonia associated with mechanical ventilation in 38.1% and hydroelectrolytic imbalance with hypokalemia in 28.6% and hypernatremia in 23.8% of cases. In the comparison table of the predominance of the lactic acid level in relation to the number of complications developed, the Chi-square stratigraphic value was 0.046, therefore, there is statistical significance with a 4% error.

Table 3. Relationship between the behavior of the lactic acid level and the number of complications developed during the evolution in the ICU.

Number of complications	Predominance of normal lactic acid	Predominance of moderate hyperlactatemia	Predominance of hyperlactatemia severe
None	27.3%	0.0%	0.0%
1-5	45.5%	57.1%	33.3%
6-10	27.3%	28.6%	33.3%
More than 10	0.0%	14.3%	33.3%

Regarding the stay, the patients who maintained a predominance of normal lactic acid levels had a stay in the ICU between eight and 21 days in 54.5%, followed by 36.4% between two and seven days, and 9.1% older than 21 days. The patients who had a predominance of moderate hyperlactatemia during their evolution in the ICU were in their highest percentage between eight and 21 days (57.1%), followed by 28.6% between two and seven days, and 14.3 %

above 21 days. Patients with a predominance of severe hyperlactatemia had a stay between two and seven days in 66.7%, followed by 33.3% between eight and 21 days, there were no patients with a stay longer than 21 days, the stratigraphic value Chi- square was 0.54, therefore, there was no statistical significance, which supports what was previously analyzed.

Table 4. Predominance of lactic acid level in relation to the days of stay in the ICU.

Days of stay in ICU	Predominance of normal lactic acid	Predominance of moderate hyperlactatemia	Predominance of severe hyperlactatemia
2-7	36.4%	28.6%	66.7%
8-21	54.5%	57.1%	33.3%
over 21	9.1%	14.3%	0.0%

Regarding the state at discharge of the traumatized patients related to the lactate level, it was verified that 100% of the patients who had a normal predominance were transferred alive, but this was not the case in the case of patients with a moderate predominance, where a 85.7% were transferred alive to another hospital unit and 14.3%, which corresponded

to a single case, died in the unit. On the other hand, of the patients with a severe predominance of lactic acid level, 66.7% were transferred alive and 33.3 % corresponded to the deceased patient. The Chi-square stratigraphic value was 0.077, therefore, there is a statistical significance with a 7% error.

Table 5. Status at discharge according to the predominance of lactic acid level during the evolution in the ICU.

Status at discharge	normal dominance		moderate prevalence		severe dominance	
	#	%	#	%	#	%
Alive	eleven	100.0%	6	85.7%	2	66.7%
Deceased	0	0.0%	1	14.3%	1	33.3%

4. Discussion

In the polytraumatized patients studied, there was a greater number of male patients, this coincides with the results found

in another investigation on the characterization of patients with thoracic trauma treated at the Enrique Cabrera Hospital (2014-2018) in Havana, in the male sex with 77.45%; In addition to another study on the epidemiology of upper limb trauma treated in six health institutions in the city of

Medellín, Colombia in 2016, where a 70.74% predominance of the male sex was found; In an investigation carried out in San Salvador, it was evidenced that 93.9% were male with similar age groups. [4-6]. The ages between 21 and 40 years were the ones with the highest frequency of trauma presentation in both sexes, which coincides with a work in Medellín, Colombia in 2016 presenting in under 40 years of age in 66.4%, this study was limited to limb trauma. However, it differs from an investigation carried out in Havana 2014-2018 described above, in which ages between 40 and 49 years predominated with 49%. [7, 8] Contrary to what was found by the authors, in Spain the number of patients affected by trauma in 2017, were in the age group comprised of pediatric ages, that is, between zero and 14 years per 1000 people. attended, A. Díaz, in 2021, sign or, that there are 25 people attended by this entity for every 1000 affected. The researchers are of the opinion that the male sex is the one that contributes the most because they are the ones who are most exposed, and to those who are most associated with the toxic habit, alcoholism, a very frequent risk factor in these tragic events. Other investigations at the University of Guayaquil [9], from 2016 to 2018 coincide with what was collected by the authors.

Likewise, Dr. Pablo Marlasca in Santander [10] found that out of 68 patients; 53 were men (77.9%) and 15 were women (22.1%). However, in Chile, Dr. Roberto González in 2018 [11]. specifically related age and sex to thoracic trauma and found that out of 4,297 patients, most of them (59.2%) corresponded to the young adult group., was more frequent in men in all age groups and a significant increase was observed in the proportion of women in the groups classified as mature adult and older adult, in another study on the epidemiological profile of polytraumatized patients admitted by the central guard of the Sanatorio Allende, Nueva Córdova, from May to August 2018, where cranioencephalic trauma was the anatomical region with the highest presentation in 46%. However, it differed with respect to the other affected anatomical regions, being variable in each one [12]. Regarding the clearance of serum lactate in polytraumatized patients in shock as a predictor of morbidity and mortality, other authors found that thoracic trauma had a greater prevalence with respect to other anatomical regions, which represents 40.81% of the total, which differs from what was found by the authors [8-13]. According to the WHO there are 10 million injured and 300 thousand deaths due to traffic accidents. Mortality from trauma is the first cause of death in children under 45 industrialized countries. It affects mainly 12 and 26% of the population, these events are avoidable if the procedures that are carried out are done correctly. The "golden hour", it is of vital importance to save the lives of patients, reach an accurate diagnosis, direct actions and minimize both pre-hospital and hospital times, they constitute the golden rule in polytraumatized care, a criterion in which they coincide 100% of medical personnel, who deal with these cases. [15]

The highest percentage of the total cases presented moderate hyperlactatemia, which coincides with a previous

investigation carried out in the intensive care unit in 2018 in the same unit, in which this same result was presented in 55.4%. of the cases, where normalization of lactic acid was found in its highest percentage (40.6%) after 48 hours. [16]. A researcher in 2017 confirmed the decrease in lactic acid levels, as the evolution of the patients progressed over time: admission, 12 hours and 24 hours, which coincides with what was evidenced by the authors. [17] This researcher, Henry Oliveras, points out that in the reviews he carried out for his research there are researchers who point out that after six hours, the usefulness of lactic acid is controversial, and point out that one of the first studies that determined the association between lactate levels and mortality in patients, was the one carried out by Abramson in 1993, which found that the delay in the normalization of lactate levels before 24 hours and 48 hours. Del Cónдор Atoche evaluated the lactate clearance within 24 hours of trauma patient admission if it is indeed a predictor of mortality, and the results were as follows: sensitivity, specificity, positive predictive value, and negative predictive value of clearance. lactate was: 85%; 28%; 27.42% and 93.3%, so lactate clearance was 74.9%, [17] considering that it turned out to be a predictor of mortality. Catalina Pineda and collaborators in Colombia in a publication in 2018, [18] point out that a high initial lactate is associated with an increase in early mortality in trauma patients. All this demonstrates the application of an adequate resuscitation protocol by medical personnel from the prehospital setting, the emergency unit and the ICU of the center, achieving correction in the first 24 hours of one of the important perfusion variables in the evaluation. prognosis of patients with severe trauma. In the previous study carried out in the same unit in 2018 coincided in that the patients who presented imbalances of the internal environment in the form of metabolic acidosis were the ones with the highest percentage of presentation, followed by Acute Respiratory Distress Syndrome and Septic Shock, which does differ with the present investigation.

Carlos Morales in Colombia in 2017, published in the Journal of Anesthesiology where he evaluates the prognostic significance of lactate in patients with trauma, it was evaluated upon admission as a biomarker of tissue hypoxia in trauma and its clearance during the first 24 hours of hospitalization, for them the initial value of lactate levels provides important information prognosis superior to clinical signs. It was confirmed by the authors that the lactate value on admission is related to mortality in polytraumatized patients. This led the authors to state that normal lactic acid levels were not related to fewer days of stay in the ICU, with the highest percentage being between eight and 21 days. [19]

In the unit in 2018, most of the deceased patients presented in the severe hyperlactatemia group, evaluating the values of lactic acid at admission, which differs from the present investigation where both in the evolutionary values by the established guidelines and its predominance, in the deceased who presented there was a predominance of moderate and severe hyperlactatemia. [19] There is no single factor that influences the mortality of polytraumatized patients,

therefore there are multifactorial causes from the very time that mediates from the impact to the first meeting with health personnel, to the actions themselves in the event. at the right time and place, which causes a cascade of events ranging from hypotension, impaired renal function tests, anemia, acidosis, decreased SaO₂, low GCS, and infections of lines and catheters, which indirectly influence the the final outcome of these cases; Therefore, there is a diversity of criteria that lactate is a predictor of mortality, which is clear that most severe traumas develop hypovolemic shock, which generates different levels of tissue hypoperfusion, so the dosage of lactate is a reliable biomarker in assessing the magnitude of hypoperfusion.

5. Conclusions

The dosage of lactic acid on admission and between six and the first 24 hours decided the evolution of these cases. The number of complications presented coincided with the biochemical evolution of the lactate dose. It was demonstrated in the study that the use of this marker in the time guidelines established by the researchers, not only behaved as a tool to evaluate prognostic clinical evolution, but also turned out to be a direct indicator that evaluated the medical action implemented in the key hours for the polytraumatized patient. The authors are of the opinion that the determination of lactic acid in the established time guidelines constitutes a guiding and prognostic tool of high value for reassessing behavior in this type of patients.

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There are no conflicts of interest.

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