ENZYMATIC PARAMETERS AT ADMISSION AND THE RISK OF DEATH IN POLITRAUMA PATIENTS WITH ASSOCIATED THORACIC TRAUMA

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ABSTRACT

Polytrauma patients represent one of the most challenging medical conditions. Developing methods of assessing the risk of death in these patients is a continuous effort for the medical field. In this study we evaluate the creatine kinase isoenzyme MB (CK-MB) and troponin as markers of increased risk of death in the first 24 hours after admission in polytrauma patients with associated thoracic trauma.

The study was conducted on 33 patients treated in the emergency department of County Clinical Emergency Hospital Constanta between 2014 and 2017.

The results of the study suggest that CK-MB does not offer additional information related to the risk of death in these patients, while in the case of troponin, higher values were observed in the patients that didn't survive after 24 hours of followup.

Keywords: *creatine kinase MB, troponin, polytrauma, thoracic trauma*

Introduction

One of the most challenging emergency is polytrauma patients, being an important cause of mortality and morbidity (1). Objective methods that allow for ways of assessing the risk the patients have, especially in the first hours after the event that produced the trauma is crucial in the management of these patients.

For these patients, different scores are used in practice in order to determine their risk, like Glasgow Coma Score (2), Injury Severity Score (3), Revised trauma score (4) or the new trauma score (5), The acute physiology and chronic health evaluation II (6) or the sequential

organ failure assessment (7). While they offer great support for the doctors and standardise the therapeutic approach, the addition of new methods of assessing the risk of the patients with multiple trauma, and in particular with multiple trauma with associated thoracic trauma can offer valuable information.

In this study, we analyze the potential of creatine kinase MB isoenzyme and troponin to be used as paraclinical tests at the initial evaluation of the polytrauma patients, with thoracic trauma, in determining the risk of death within the first 24 hours after admission.

Material and method

We studied 33 patients with severe thoracic polytrauma, admitted through the emergency room of County Clinical Emergency Hospital Constanta between 2014 and 2017.

Inclusion criteria were age – over 16 years old, diagnosis of major polytrauma with thoracic trauma. We excluded from the study patients for whom information about the mechanism of trauma was unknown or a medical background was impossible to obtain.

We compared the values, at admission, for creatine kinase MB isoenzyme (CK-MB) and troponin between patients that survived 24 hours after admission and patients that died during the same period of time.

In order to determine the statistical tests to run (parametric or nonparametric), we assessed the normality of the data by observing the histogram and running the Shapiro-Wilk test. Depending on the results, we ran t test or Mann-Whitney U test to compare the values among the two groups of patients.

After comparing the values, we decided to run a second type of test in which we transformed the data according to existing literature, considering the CK-MB cutoff point as being 24 UI/L, and in the case of troponin as negative for values less than 0 and 0.02 ng/mL, Positive + for values 0.021 – 0.06 ng/mL, Positive ++ for values between 0.061 and 0.22 ng/mL, and Positive +++ for values above 0.22. After the transformation we ran Chi-square test for testing the association between the patients status after 24 hours and enzymes values.

For all statistical tests, we considered the result as being statistically significant for p values less or equal to 0.05.

Results

From the sample of 33 patients, 11 died in the first 24 hours, while 22 survived. The average age in the survivors group was 48.73 years, with standard deviation of 14.01 and median value of 50. For the group of patients that died within 24 hours after admission, the average age was 50.64 years, with standard deviation of 12.37

and median value of 57. The difference was not statistically significant ($p=0.704$). For both groups, males represent most of the patients, 16 patients (72.7%) being males in the survivors group and 9 patients (81.8%) being males in the group of the deceased patients. There is no statistically significant difference according to gender distribution between the groups ($p=0.566$).

Creatine kinase MB (CK-MB)

Analysing the CK-MB values, we observed the fact that average values in the case of deceased patients is more than double when compared to patients that survived (248 U/L compared to 106.64 U/L), while the median was similar, 60 UI/L (Table 1).

Table 1 Descriptive statistical analysis for CK-MB between the two groups

	Died within 24 hours of admission		
	No	Yes	Total
N	22	11	33
Mean	106.64	248.00	153.76
Standard deviation	106.844	262.20	183.18
Median	60.00	60.00	60.00
Variance	11415.576	68751.00	33555.75
Skewness	1.392	.699	1.64
Kurtosis	.850	-1.32	1.92
Minimum	19	20	19
Maximum	350	700	700

The Shapiro-Wilk test had statistically significant results, with p values less than 0.001 for both groups (Table 2). In figure 1 we represent the distribution of the patients according to CK-MB values. We noted that most of the patients have values less than 50 UI/L, summing up to 36% of the deceased patients and 41% of the patients in the survivors group. Based on the results of the test and the observation of the histogram, we concluded that the data does not follow a normal distribution, therefore, for comparison, we used nonparametric tests.

Table 2 Shapiro-Wilk test for CK-MB

Died within 24 hours of admission		Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
CK-MB at admission	No	.271	22	.000	.775	22	.000
	Yes	.309	11	.004	.803	11	.010

Figure 1 Distribuția valorilor CK-MB la internare comparativ în funcție de evoluția pacienților

Ranks test (Table 3) indicates that the mean range is significantly higher for deceased patients group, with a value of 19.64, while for the survivors is 15.98. This indicates, once more, that patients that died had higher values of CK-MB compared to the survivors.

Table 3 CK-MB Ranks

	Died within 24 hours of admission	N	Mean Rank	Sum of Ranks
CK-MB at admission	No	22	15.68	345.00
	Yes	11	19.64	216.00
	Total	33		

The result of the test was not significant ($z=-1/101$, $p=0.268$) (Table 4)), suggesting that there is no statistically significant difference between the two groups when comparing the CK-MB values.

Table 4 Mann-Whitney U test for CK-MB

CK-MB at admission	
Mann-Whitney U	92.000
Wilcoxon W	345.000
Z	-1.109
Asymp. Sig. (2-tailed)	.268
Exact Sig. [2*(1-tailed Sig.)]	.281 ^b

Association between CK-MB at admission and risk of death

From the total of 11 patients that died during the first 24 hours after admission, one patients had normal values of CK-MB, while 10 of them had elevated values. At the same time, among the 22 patients that survived after the first 24 hours after admission, 3 had normal values and 19 elevated values. Thus, the percentages of patients with normal values were 13.6% in the survivors group and 9.1% in the deceased group

(Table 5).

Table 5 Patients evolution and CK-MB category crosstabulation

			Died within 24 hours of admission		Total
			No	Yes	
CK-MB category	Normal	Counts	3	1	4
		% din Died within 24 hours of admission	13.6%	9.1%	12.1%
	Elevated	Counts	19	10	29
		% din Died within 24 hours of admission	86.4%	90.9%	87.9%
Total % din Died within 24 hours of admission		Counts	22	11	33
		100.0%	100%	100%	

By running the Chi-Square test, the result is not statistically significant ($p=0.7$), indicating the lack of association between CK-MB category and risk of death.

Troponin

For troponin, mean values for deceased patients were 1.24 ng/mL, with a standard deviation of 1.66 ng/mL. For patients that survived, the mean values for troponin were 0.039 ng/mL, with a standard deviation of 0.063 ng/mL. Median values are significantly different, with 0.012 ng/mL for surviving patients and 0.73 ng/mL for deceased patients (Table 6).

Table 6 Descriptive statistics for troponin

	Died within 24 hours of admission		
	Yes	No	Total
N	22	11	33
Mean	.03955	1.24055	.43988
Standard Deviation	.06287	1.6667	1.09605
Median	.01200	.07300	.03000
Variance	.004	2.778	1.201
Skewness	2.109	.722	2.482
Kurtosis	3.750	-1.738	4.583
Minimum	.000	.020	.000
Maximum	.220	3.800	3.800

According to the result of Shapiro-Wilk test (Table 7) and the histogram (Figure 2), the distribution of troponin values differ in a statistically significant ($p<0.001$) and graphical

way from a normal distribution. Therefore, for comparing the values we used the nonparametric

Figure 2 Distribution according to troponin

Graphically, we notice the fact that in the case of deceased patients, none of them have troponin values less than 0.02 ng/mL, while in the case of the patients that survived the first 24 hours, almost 60% of them have values less than 0.02 ng/mL. Also, in the case of the deceased patients, 36.37% had values higher than 3 ng/mL.

Comparing the ranks, the average rank in the deceased patients group was 24.41, significantly higher when compared to the survivors group, for which the average rank was 13.3 (Table 8).

Table 8 Troponin ranks

	Died within 24 hours of admission	N	Mean Rank	Sum of ranks
Troponin at admission	No	22	13.30	292.50
	Yes	11	24.41	268.50
	Total	33		

The observed difference was statistically significant ($z=-3.126$, $p=0.002$) (Table 9). This sustains, with a high degree of confidence the fact that patients that survived the first 24 hours after admission had significantly lower values of troponin.

Table 9 Aplicarea testului Mann Whitney-U pentru valorile troponinei în funcție de evoluția pacienților

	Troponina la internare
Mann-Whitney U	39.500
Wilcoxon W	292.500
Z	-3.126
Asymp. Sig. (2-tailed)	.002
Exact Sig. [2*(1-tailed Sig.)]	.001 ^b

Risk of death according to troponin values

For estimating the association between troponin category and risk of death, we crosstabulated the data. The results, from table 10, show that in the group of patients that died within 24 hours of admission, all of them were in the category Positive ++ (4 patients) or Positive +++ (7 patients). In the group of survivors, from the total of 22 patients, 6 were considered to be negative, 7 Positive +, 5 Positive ++ and 4 Positive +++.

Table 10 Patients evolution and troponin category crosstabulation

No Yes			Died within 24 hours of admission		Total
Troponin category	Negativ	Counts	6	0	6
		% from Died within 24 hours of admission	27.3%	0.0%	18.2%
	Positive +	Counts	7	0	7
		% from Died within 24 hours of admission	31.8%	0.0%	21.2%
	Positive ++	Counts	5	4	9
		% from Died within 24 hours of admission	22.7%	36.4%	27.3%
	Positive +++	Counts	4	7	11
		% from Died within 24 hours of admission	18.2%	63.6%	33.3%
Total % from Died within 24 hours of admission		Counts	22	11	33
		100%	100%	100%	

The graphical representation of the proportion (Figure 3) offer a better insight on the distribution of the patients based on troponin category.

Figure 3 Patients distribution according to troponin category and survival at 24 hours after admission

When applying the chi-square test, the percentage of cells with expected values less than 5 is higher than 20%, therefore, we considered the statistical significance obtained from the Likelihood Ratio, which is 0.002. This result indicates that there is a significant association between troponin category and risk of death, thus, positioning a patient into Positive ++ or Positive +++ indicates a significantly higher risk of death in the first 24 hours after admission.

Table 11 Chi-square test for troponin

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.545 ^a	3	.009
Likelihood Ratio	15.224	3	.002
N of Valid Cases	33		

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is 2.00.

Discussion

In the case of CK-MB we observed that almost 90% of all the patients had increased values. Combined with the fact that the percentage of patients with elevated values was almost identical in both groups (86.4% vs 90.9%), results in the conclusion that CK-MB is not helpful in identifying the risk of death in patients with polytrauma and associated thoracic trauma. Other studies concluded that CK-MB is not useful in determining cardiac injury as it is not specific enough (8).

In the case of troponin, this proved to increase more in patients that didn't survived in the first 24 hours after admission. There are a number of studies that proved the fact that trauma

patients with increased troponin values are of greater death risk, representing a real challenge (9, 10).

The particularity of this study is the fact that the patients considered have polytrauma with associated thoracic trauma. We didn't tried to identify subsequent organ (cardiac) involvement, as we considered only the main outcome, death within 24 hours of admission as the only objective of this study.

Conclusions

Increased values of creatine kinase MB isoenzyme do not associate with higher risk of death, while troponin values suggest to be useful during initial assessment of polytrauma patients with thoracic trauma in identifying patients with increased risk of death.

References

1. World Health Organization. Global burden of disease. Geneva: WHO Press; 2015.
2. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet (London, England). 1974;2(7872):81-4.
3. Baker SP, O'Neill B, Haddon W, Jr., Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14(3):187-96.
4. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma. 1989;29(5):623-9.
5. Jeong JH, Park YJ, Kim DH, Kim TY, Kang C, Lee SH, et al. The new trauma score (NTS): a modification of the revised trauma score for better trauma mortality prediction. BMC Surgery. 2017;17(1):77.
6. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Critical care medicine. 1985;13(10):818-29.
7. Vincent JL, de Mendonca A, Cantraine F, Moreno R, Takala J, Suter PM, et al. Use of the SOFA score to assess the incidence of organ dysfunction/failure in intensive care

units: results of a multicenter, prospective study. Working group on “sepsis-related problems” of the European Society of Intensive Care Medicine. *Critical care medicine*. 1998;26(11):1793-800.

8. Bansal MK, Maraj S, Chewaproug D, Amanullah A. Myocardial contusion injury: redefining the diagnostic algorithm. *Emergency Medicine Journal*. 2005;22(7):465-9.
9. Mahmood I, El-Menyar A, Dabdoob W, Abdulrahman Y, Siddiqui T, Atique S, et al. Troponin T in patients with traumatic chest injuries with and without cardiac involvement: Insights from an observational study. *North American Journal of Medical Sciences*. 2016;8(1):17-24.
10. Lippi G, Buonocore R, Mitaritunno M, Cervellin G. Cardiac Troponin I Is Increased in Patients with Polytrauma and Chest or Head Trauma. Results of A Retrospective Case-Control Study. 2016;35(3):275.