N-TERMINAL PRO-B-TYPE NATRIURETIC PEPTIDE – PROGNOSTIC VALUE FOR DEATH WITHIN 24 HOURS IN SEVERE POLYTRAUMA PATIENTS WITH CHEST TRAUMA

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ABSTRACT

Patients with multiple trauma with thoracic trauma have higher death rates compared to multiple trauma patients without thoracic trauma, mainly because of cardiac injury. We investigated the 24 hours prognostic value of NT-proB-type Natriuretic Peptide (Nt-ProBNP) in polytraumatised patients with thoracic trauma.

The study group was composed of 33 patients, 25 males and 8 females. During the study, the endpoint, which was death in the first 24 hours after admission was observed in 33% of the patients (11 patients).

Using a cut-off point of 125 pg/ml, the sensitivity of the test was 100% and the specificity was 59.09%.

According to the results of the study, NT-ProBNP proves that it might be useful in detecting patients with a bad prognosis, the analyzed enzyme having the capacity of identifying polytrauma patients with thoracic trauma that have high risk of death in the first 24 hours after admission.

Keywords: natriuretic peptide brain, NT-proBNP, polytrauma, thoracic trauma, emergency medicine

Introduction

Polytrauma and, in particular, thoracic trauma represent major emergencies, with high mortality risk, especially in younger population (1). The risk of death for patients experiencing severe trauma is high, approximately half them die in prehospital, and with high death rates in the first 24 to 72 hours after hospitalization (2).

Thoracic trauma is one of the main causes of death in polytrauma patients together with abdominal and head trauma (3). Also, studies revealed the fact that patients with polytrauma that associate chest trauma have higher death

rates compared to polytrauma patients without chest trauma (4).

We investigated the 24 hours prognostic value of NT-proB-type Natriuretic Peptide (Nt-ProBNP) in polytraumatised patients with thoracic trauma.

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.

For the purpose of the study, we measured, at the time of admission, NT-ProBNP levels. The endpoint of the study was considered mortality, within 24 hours from admission.

We used Matlab to calculate the accuracy of NT-ProBNP into identifying patients with very high risk of death in the next 24 hours. We decided to report the results by means of describing the receiver operating characteristic curve (ROC curve), which offers the sensitivity and sensibility for each cut point we obtained, and also we used the contingency table to report the results according to values that are specified in the medical literature (5).

Results

The study group was composed of 33 patients, 25 males and 8 females. During the study, the endpoint, which was death in the first 24 hours after admission was observed in 33% of the patients (11 patients).

For the survivors group, the average age was 48.73 years, with a standard deviation of 14.01 years and median of 50 years, while for the patients that died, the average age was 50.64, standard deviation 12.37 and median of 57 years. No statistically significant difference between groups was observed ($p=0.7$).

Gender comparison between the two groups (patients that survived vs patients that died in the first 24 hours after admission) showed no statistically significant difference according to gender or living environment (Table I).

The Glasgow Coma Score (GCS) was significantly lower in patients that died, with an average of 5.91, standard deviation of 4.56 and median of 3, compared to patients that survived, with an average of 12.45, standard deviation of 3.82 and median of 14.5.

NT-ProBNP values were significantly lower in the survival group, with an average of 203.23 pg/ml, standard deviation of 223.28 pg/ml and median of 80 pg/ml, compared to the deceased group where average value was 854.91 pg/ml, standard deviation 1845.12 pg/

ml and median of 300 pg/ml. Because of the extreme values observed, for comparison we used logarithmic transformation. In Figure 1 we represent the distribution of NT-ProBNP values after logarithmic transformation.

Table I Baseline Characteristics of the Participants

	Survived (n=22)	Died (n=11)	p
Age (years)	48.73 (sd=14.011)	50.64 (sd 12.372)	0.7
Gender (Males)	72.7% (n=16)	81.8% (n=9)	0.68
Environment (Urban)	63.6% (n=14)	63.6% (n=7)	1
Glasgow Coma Score	12.45 (sd=3.82)	5.91 (sd=4.65)	0.001
NT-ProBNP (pg/ml)	203.23 (sd=223.38)	854.91 (sd=1845.18)	0.028

Figure 1 Distribution of the patients according to NT-ProBNP values

In order to determine the best cut-off points for positivity of NT-ProBNP values, we calculated the area under ROC curve, which was 0.738 with a 95% confidence interval of 0.556 – 0.875, this being statistically significant different from the 0.5 curve ($p=0.0062$) (Table II).

Table II Area under ROC curve

Area under ROC curve	0.738
Standard Error	0.0869
Confidence interval 95%	0.556 to 0.875
z statistic	2.735
Significance level P (Area=0.5)	0.0062

Youden index, which is used for determining the best criterion to use based on the available data is 0.5909 for a cut-off positivity value of 120 pg/ml. For this value, the sensitivity

of the test is 100% and the specificity is 59.09% (Table III).

Table III Youden index J

Youden index J	0.5909
Associated criterion	>120
Sensitivity	100.00
Specificity	59.09

The graphical representation of the ROC curve (Figure 2) shows the criterion points for which sensitivity and specificity (Table IV) were calculated.

Best sensitivity scores (100%) were obtained for criteria of less than 120 pg/ml, while best specificity scores were obtained for values higher than 600 pg/ml.

Table IV NT-ProBNP performance

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	95% CI	-LR	95% CI	+PV	95% CI	-PV	95% CI
≥14	100.00	71.5 - 100.0	0.00	0.0 - 15.4	1.00	1.0 - 1.0			33.3	18.0 - 51.8		
>14	100.00	71.5 - 100.0	4.55	0.1 - 22.8	1.05	1.0 - 1.1	0.00		34.4	18.6 - 53.2	100.0	2.5 - 100.0
>15	100.00	71.5 - 100.0	9.09	1.1 - 29.2	1.10	1.0 - 1.3	0.00		35.5	19.2 - 54.6	100.0	15.8 - 100.0
>20	100.00	71.5 - 100.0	18.18	5.2 - 40.3	1.22	1.0 - 1.5	0.00		37.9	20.7 - 57.7	100.0	39.8 - 100.0
>25	100.00	71.5 - 100.0	27.27	10.7 - 50.2	1.37	1.1 - 1.8	0.00		40.7	22.4 - 61.2	100.0	54.1 - 100.0
>40	100.00	71.5 - 100.0	31.82	13.9 - 54.9	1.47	1.1 - 2.0	0.00		42.3	23.4 - 63.1	100.0	59.0 - 100.0
>50	100.00	71.5 - 100.0	40.91	20.7 - 63.6	1.69	1.2 - 2.4	0.00		45.8	25.6 - 67.2	100.0	66.4 - 100.0
>60	100.00	71.5 - 100.0	50.00	28.2 - 71.8	2.00	1.3 - 3.0	0.00		50.0	28.2 - 71.8	100.0	71.5 - 100.0
>100	100.00	71.5 - 100.0	54.55	32.2 - 75.6	2.20	1.4 - 3.5	0.00		52.4	29.8 - 74.3	100.0	73.5 - 100.0
>120	100.00	71.5 - 100.0	59.09	36.4 - 79.3	2.44	1.5 - 4.0	0.00		55.0	31.5 - 76.9	100.0	75.3 - 100.0
>130	90.91	58.7 - 99.8	59.09	36.4 - 79.3	2.22	1.3 - 3.8	0.15	0.02 - 1.0	52.6	28.9 - 75.6	92.9	66.1 - 99.8
>134	81.82	48.2 - 97.7	59.09	36.4 - 79.3	2.00	1.1 - 3.6	0.31	0.08 - 1.1	50.0	26.0 - 74.0	86.7	59.5 - 98.3
>150	81.82	48.2 - 97.7	63.64	40.7 - 82.8	2.25	1.2 - 4.2	0.29	0.08 - 1.0	52.9	27.8 - 77.0	87.5	61.7 - 98.4
>180	72.73	39.0 - 94.0	63.64	40.7 - 82.8	2.00	1.0 - 3.9	0.43	0.2 - 1.2	50.0	24.7 - 75.3	82.4	56.6 - 96.2
>190	72.73	39.0 - 94.0	68.18	45.1 - 86.1	2.29	1.1 - 4.7	0.40	0.1 - 1.1	53.3	26.6 - 78.7	83.3	58.6 - 96.4
>220	54.55	23.4 - 83.3	68.18	45.1 - 86.1	1.71	0.8 - 3.9	0.67	0.3 - 1.4	46.2	19.2 - 74.9	75.0	50.9 - 91.3
>300	45.45	16.7 - 76.6	72.73	49.8 - 89.3	1.67	0.7 - 4.3	0.75	0.4 - 1.4	45.5	16.7 - 76.6	72.7	49.8 - 89.3
>320	36.36	10.9 - 69.2	72.73	49.8 - 89.3	1.33	0.5 - 3.8	0.88	0.5 - 1.5	40.0	12.2 - 73.8	69.6	47.1 - 86.8
>400	27.27	6.0 - 61.0	72.73	49.8 - 89.3	1.00	0.3 - 3.3	1.00	0.6 - 1.6	33.3	7.5 - 70.1	66.7	44.7 - 84.4
>450	27.27	6.0 - 61.0	77.27	54.6 - 92.2	1.20	0.3 - 4.1	0.94	0.6 - 1.4	37.5	8.5 - 75.5	68.0	46.5 - 85.1
>490	27.27	6.0 - 61.0	81.82	59.7 - 94.8	1.50	0.4 - 5.6	0.89	0.6 - 1.3	42.9	9.9 - 81.6	69.2	48.2 - 85.7
>500	18.18	2.3 - 51.8	86.36	65.1 - 97.1	1.33	0.3 - 6.8	0.95	0.7 - 1.3	40.0	5.3 - 85.3	67.9	47.6 - 84.1
>550	18.18	2.3 - 51.8	90.91	70.8 - 98.9	2.00	0.3 - 12.4	0.90	0.7 - 1.2	50.0	6.8 - 93.2	69.0	49.2 - 84.7
>600	9.09	0.2 - 41.3	95.45	77.2 - 99.9	2.00	0.1 - 29.0	0.95	0.8 - 1.2	50.0	1.3 - 98.7	67.7	48.6 - 83.3
>642	9.09	0.2 - 41.3	100.00	84.6 - 100.0			0.91	0.8 - 1.1	100.0	2.5 - 100.0	68.8	50.0 - 83.9
>6400	0.00	0.0 - 28.5	100.00	84.6 - 100.0			1.00	1.0 - 1.0			66.7	48.2 - 82

Figure 2 ROC curve for NT-ProBNP

Table V Crosstabulation for death within 24 hours of admission and NT-ProBNP category (cut-off point 125 pg/ml)

			Death within 24 hours of admission		Total
			No	Yes	
NT-ProBNP	Normal (≤125 pg/ml)	Count	13	0	13
		% within Death within 24 hours of admission	59.1%	0.0%	39.4%
	Elevated (>125 pg/ml)	Count	9	11	20
		% within Death within 24 hours of admission	40.9%	100.0%	60.6%
Total		Count	22	11	33
% within Death within 24 hours of admission		100.0%	100.0%	100.0%	

Using a cut-off point of 125 pg/ml, the sensitivity of the test was 100% and the specificity was 59.09%. Complete analysis - Table VI.

Table VI Test accuracy for NT-ProBNP cut-off point value of 125 pg/ml

	Value	CI 95%
Sensitivity	100.00%	71.51% to 100.00%
Specificity	59.09%	36.35% to 79.29%
AUC	0.80	0.62 to 0.92
Positive Likelihood Ratio	2.44	1.48 to 4.04
Negative Likelihood Ratio	0.00	
Disease prevalence	33.33%	17.96% to 51.83%
Positive Predictive Value	55.00%	31.53% to 76.94%
Negative Predictive Value	100.00%	75.29% to 100.00%

Discussion

The results offer an important perspective on using it for initial evaluation of the patients. The results indicate that a cut-off point of 125 pg/ml is suitable for the test, having the capacity of correctly identifying patients at risk of 100% and of correctly identifying patients with low risk of 59.09%.

Studies proved that NT-ProBNP levels correlate with cardiac impairment (7) in patients with multiple injuries. Also, in a study from 2015 (8) the authors concluded that NT-ProBNP analysis might offer additional information for the diagnosis of cardiac traumatism in the initial evaluation of patients with thoracic trauma.

Other studies analyzed the importance of determining NT-ProBNP values in patients that undergone thoracic surgery (9-11), patients with heart failure (12) or in patients that undergo surgery for abdominal aneurisms (13).

Limitations of this study are related especially to the unknown cardiac status of the patients before hospital admission, therefore the impossibility of determining if the increase of NT-ProBNP values in some of them are because of the induced trauma or because of a preexisting condition.

Conclusions

According to the results of the study, NT-ProBNP proves that it might be useful in detecting patients with a bad prognosis, the analyzed enzyme having the capacity of identifying

polytrauma patients with thoracic trauma that have high risk of death in the first 24 hours after admission.

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