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Serum Troponin Levels, APACHE II Score and Mortality Rate for Non-Cardiac Reasons in RCU Patients

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ABSTRACT

Background: *Estimating the severity of disease and prognosis for patients hospitalized in intensive care units may be important in selection of diagnostic procedures and treatment regimens. For this purpose, various ranking methods have been used in these units which have their benefits and shortcomings.*

Materials and Methods: *In this study, all patients admitted to the respiratory intensive care unit (RCU) of Labbafi Nejad Hospital during the year 2005 with no signs of cardiac disease or history of cardiopulmonary resuscitation were evaluated. All patients had their serum troponin level checked in the first hour of hospitalization in the unit and upon first medical examination acute physiologic and chronic health evaluation (APACHE) II scores were determined for them. In total, 87 patients were eligible for entering the study.*

Results: *There were significant correlations between serum troponin levels and APACHE II score (p=0.0001). There was also a significant correlation between elevated troponin levels and mortality rate. Multivariate statistical analysis showed that APACHE II scores and serum troponin levels each are independent variables affecting prognosis among hospitalized patients in the respiratory intensive care unit.*

Conclusion: *Determination of serum troponin levels in non-cardiac patients admitted to respiratory intensive care unit can be a helpful prognostic factor.* ***(Tanaffos 2009; 8(1): 29-34)***

Key words: *Troponin, APACHE II score, Mortality rate, Respiratory intensive care unit*

INTRODUCTION

Estimation of the severity of illness and prognosis of patients hospitalized in the ICU can be influential in selection of diagnostic and treatment measures (1-4). For this purpose, various ranking system have been utilized (5,6) to quantify patient's condition and be able to compare patients and ICU locations and evaluate more precisely outcome of treatment and diagnostic methods among similar patients.

Another indication for the quantitative scorings is the comparison of quality of care in ICUs among different hospitals.

The most common systems applied are:

-Mortality prediction model (MPM)

-Acute Physiologic and Chronic Health Evaluation II

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(APACHE II)

- Simplified Acute Physiologic Score (SAPS)

All the mentioned systems include common variables such as age, vital signs at presentation and during hospital stay, pulmonary function tests, renal function tests, level of consciousness, electrolyte status and underlying disease (7-11). The most important shortcomings of these systems are regarding the underlying disease and time consuming nature of filling the related forms (5-8). For this reason, a substitute test has constantly been looking for in these patients that does not have these disadvantages.

Troponin which is a protein regulator of actin-myosin interaction in the presence of calcium is measured as an index of myocardial cellular injury (12). Troponin level is the most sensitive and specific biochemical test currently in use for detecting myocardial damage and can be elevated in ill patients even without EKG changes (12-14). Increased serum troponin levels in patients hospitalized in ICU can be predictive of the outcome for them (15).

MATERIALS AND METHODS

The study population included all patients admitted to the RCU of Labbafi Nejad Hospital in the year 2005. Patients admitted with the diagnosis of cardiac condition based on history, physical exam and clinical findings or those who underwent CPR before the admission to the RCU were excluded from the study. Those with other conditions such as sepsis, pulmonary emboli and etc. that can raise troponin levels were not excluded since troponin itself may have a prognostic value in these conditions.

With a confidence interval of 95%, power of 80%, standard error of 70% and frequency of elevated troponin levels found in 20% of patients hospitalized in ICU, under study population was calculated to be 75 patients. This number was 87 cases in our study.

All patients underwent serum troponin level determination during their first hour of hospitalization in RCU and the blood samples were sent to the same laboratory and measurements were done with ELISA in all cases. The patient's APACHE II score was evaluated by the attending physician in the first visit. Considering troponin as a quantitative variable, its correlation with the APACHE II score was assessed using the bivariate Correlation method with regression analysis and calculation of the Pearson coefficient. Also, the amount of APACHE II score was evaluated for patients with positive or negative troponin tests using the t-test. Finally, multivariate analysis was performed to determine the APACHE II indices and the troponin level as an indicator of patient's prognosis.

Data were analyzed using SPSS II software and $P<0.05$ was considered as significant.

RESULTS

In total, 87 patients met the criteria to enter the study. The mean age of patients was 53 years (64.52±15 yrs, range 22-84 yrs) and there were 40 females (46%) and 47 (54%) males. The most common reason for admission was COPD exacerbation (27.6%). Admission diagnoses for patients are shown in Table 1.

Among all patients, 24 had positive troponin (>3.1) which consisted 27.6% of ICU patients without significant cardiac symptoms or EKG changes.

The mortality rate was 19.5% (n=17). The APACHE II score for the patients was 21.8±7.18 and this level was significantly higher among troponin positive patients (Table 2).

Table 1. Frequency of various diagnoses in ICU patients without cardiac conditions in Labbafi Nejad Hospital

Diagnosis	Number	Percentage
COPD	24	27.6
Pulmonary Emboli	18	20.7
Asthma	12	13.8
Renal Failure	10	11.5
Sepsis and ARDS	8	9.2
Pneumonia	8	9.2
Lung Cancer	4	4.6
Trauma	2	2.3
Warfarin Toxicity	1	1.1
Total	87	100

Table 2. APACHE II score based on positive or negative troponin levels

Troponin	Positive	Negative	T	P
APACHE				
Mean ± SD	26.67±7.06	19.95±6.3	4.274	0.0001

The correlation coefficient between troponin levels and APACHE II scores was 0.396 which was statistically significant (Pearson correlation coefficient was 0.396, p=0.0001). Our results indicated that morbidity and mortality rate increased significantly with increased APACHE II score and the mean APACHE II score was 26.65±6.36 for deceased patients and 20.63±6.9 for those who survived (Pearson correlation coefficient was 0.334, p=0.002)(Table 3).

Table 3. The correlation between APACHE II score and mortality rate.

Mortality	Deceased N=17	Survived N=70	T	P
APACHE				
Mean ± SD	26.64±6.36	20.63±6.9	3.272	0.002

Our results showed that morbidity and mortality increased significantly with increased troponin levels which were 9.035±2.22 among deceased patients and 3.35±0.75 for those who survived (Table 4). Also, 11 patients (45.8%) in the troponin positive group and 6 patients (9.5%) in the troponin negative group passed away. The ratio of morbidity and mortality in the troponin positive group compared to the negative group was 8.038 (25.17±2.51 CI= 95%) and this difference was statistically significant (P=0.0001, X^2=14.75).

Even though the creatinine level was higher in the elevated troponin group it was not considered statistically significant (p=0.451).

Table 4. The correlation between mortality rate and serum troponin level.

Troponin / Mortality rate	Negative N(%)	Positive N(%)	X^2	P
Survived	57(90.5%)	13(54.2%)		
Deceased	6 (9.5%)	11(45.8%)	14.57	0.0001
Total	63 (100%)	24 (100%)		

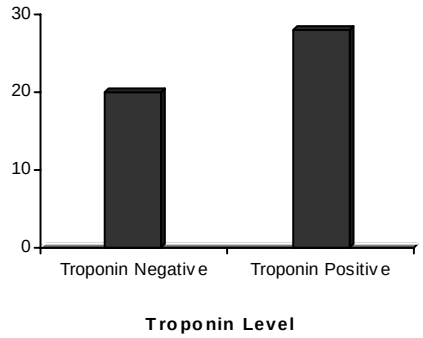

Figure 1. APACHE II score based on troponin test

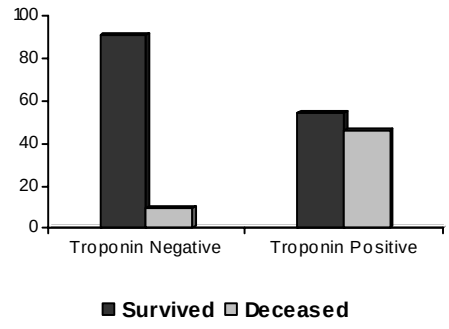

Figure 2. Mortality rate based on troponin test.

Table 5. The correlation of troponin level with mortality rate.

Mortality	Deceased N=17	Survived N=70	T	P
Troponin Mean ± SD	9.035±2.22	3.35±0.75	2.43	0.025

Table 6. The co-variate analysis of variables.

Co variate	Beta	SD	T	P
Troponin	0.223	0.006	2.04	0.045
APACHE	0.246	0.006	2.3	0.027

DISCUSSION

Despite the high accuracy of scoring systems for ICU patients, search for other indices continues. The two main reasons are that they are time consuming and patients with underlying illnesses face confounders (5,6). In other words, despite efforts to quantify patient status in ICU, qualitative variables such as underlying diseases prevent high accuracy for the methods used.

There are 2 methods to quantify patient status: first is to improve the already present scoring systems and add other factors and variables to them and omit less important variables. However, this is complicated and requires time and approval of the new variable by the use of cohort studies. Second is relying on more sensitive and specific indices which can be individually evaluated for each patient. The purpose of this study was to find if a correlation exists between serum cardiac troponin I levels and APACHE II scores and mortality rate in ICU patients admitted for non-cardiac reasons (7).

Our results showed that 27.6% of patients had increased troponin levels and the mortality rate was also higher among these patients. Considering the design of this study, initially uni-variate analysis was performed between APACHE II score and troponin level, between APACHE II score and mortality rate and between troponin levels and mortality rate.

In other words, using separate statistical analyses, the correlation between the variables on a two by two basis was assessed and significant correlations between patients' scores in the first 24 hours post admission and troponin level and between mortality rate and other variables were found. As a result, a significant correlation was found between APACHE II score and serum troponin level which can be very useful in prognosis determination of ICU patients. Yet, it should be emphasized that serum troponin levels and APACHE II scores are not interchangeable as prognostic indicators but can be of value in narrowing down the APACHE II system scoring divisions. As an example, in situations with underlying diseases, confounders and similar APACHE II scores, troponin level can be a practical and useful index.

The next step in our study was multivariate analysis to determine the influence of serum troponin level as a prognostic indicator. In other words, we evaluated serum troponin level as an independent variable in prognostic information. The multivariate analysis showed that elevated troponin level can independently predict prognosis in ICU patients. First, the correlation between the troponin level and APACHE II scores was shown and next it was shown that elevated troponin level can be used independently as a prognostic indicator for ICU patients admitted for non-cardiac reasons.

Many studies have been performed in this regard. In a study by King et al. patients with elevated troponin levels had higher APACHE II scores and mortality rate was also higher in this group. Yet, they concluded that elevated troponin level is not an independent prognostic factor; although, the level of statistical significance was close to meaningful (P=0.085) (1).

In a study by Quenot et al. troponin level was found to be an independent prognostic factor and it was compared with SAPS system of scoring used in

Europe. In this study also, cardiac patients were excluded (2).

Lim et al. in their study with less strict inclusion criteria which even included acute myocardial infarction patients found that near half the ICU patients had elevated troponin levels and 26% developed myocardial infarction (3).

King et al. explained the nature of troponin level as a dependent variable by stating that it only represented damage to one system while APACHE II scoring includes many variables (1).

Although scoring systems can quantify patient's status, they cannot accurately convert underlying diseases into quantitative or qualitative measures and they also have particular biases (5). In our study as well as some others' (2,3,5), prognosis for ICU patients was evaluated on a general basis and as a result, the influence of underlying disease was minimized.

Douketis et al. found that elevated troponin levels in pulmonary emboli patients were associated with 30% increase in mortality rate (19).

Perna and colleagues in their study showed that elevated troponin level is an independent predictor of patients' status and high mortality rate in heart failure patients (20).

Ver Elst noted that elevated troponin levels were associated with increased level of disability and mortality rate in sepsis patients and found correlation between APACHE II score and serum troponin levels (11).

In a study by Feldman et al., the effect of the cytokine TNF was evaluated on heart failure and myocardial injury (17). TNF is an inflammatory cytokine which increases during inflammation and can affect various tissues and cause biochemical changes. Other inflammatory cytokines such as IL-1 can do the same. These cytokines can injure myocardial cells and release troponin in the heart. Therefore, increased serum troponin level is not only an index of myocardial injury, but also is a sign of inflammatory reaction. Elevated troponin level can be considered as an indicator of damage to several organs since cytokines can cause injury to organs other than heart as well.

In support of the above, it should be noted that in our study as well as in most of the aforementioned studies, a significant correlation was found between APACHE II score and even SAPS with troponin levels. Therefore, these multivariable scoring systems are correlated with one index (troponin) and additionally, multivariate analysis in our and similar studies supported troponin level as an independent prognostic factor.

Therefore, the two step analysis in our study and also other studies indicated the role of troponin level as a prognostic indicator of patient status not only in cardiac patients but also in those with other inflammatory conditions and the significant correlation between the troponin level and multivariate scoring systems is due to myocardial response to inflammatory cytokines in circulation. In other words, troponin can be used as an index of inflammatory process and as a substitution for scoring systems to predict prognosis in patients hospitalized in ICU.

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