

Diagnostic Value of Troponin I and T to Predict Mortality in Patients Undergoing Hemodialysis

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Background: There is no known biomarker to predict the mortality risk in patients undergoing dialysis in the intensive care unit (ICU). Therefore, the current study aimed to determine the diagnostic value of troponin I and T in this respect.

Methods: This prospective study included 70 patients, admitted to the intensive care unit, during 2016-2017, who need hemodialysis.

In these participants, the serum levels of troponin T and I were measured and the result of treatment was recorded in the patient's profile whether it was improvement or death.

Finally, we analyzed the diagnostic value of troponin T and I was predict the mortality in these patients in SPSS software version 20 through the Rock analysis.

Results: The mean of troponin I and T levels in alive patients were 0.47 ± 0.11 ng/ml and 0.67 ± 0.15 ng/ml, respectively and in dead were 0.49 ± 0.23 ng/ml and 1.06 ± 0.36 ng/ml, respectively. There was no significant difference between alive and dead patients in the mean of both troponins levels (P value > 0.05). On the other hand, Rock analysis also demonstrated that statistically these two biomarkers did not have any significant diagnostic value to predict mortality (P value > 0.05).

Conclusion: According to the results, it is conceivable that troponin I and T are not proper biomarkers to predict the mortality in patients undergoing dialysis in ICU and these biomarkers do not have a proper sensitivity and specificity for this purpose.

Keywords: hemodialysis; troponin T; troponin I; mortality

One of the most relatively common and important diseases in adults is renal failure. Renal disease remains hidden to the advanced stages without any specific sign. In many people with chronic diseases, the renal disease progresses to the end stage and renal failure; thus, dialysis or renal transplantation would be required [1-2].

Patients with renal failure are exposed to higher risk of myocardial infarction (MI). The number of serum biomarkers which can result in myocardial damage such as creatinine kinase, myoglobin, troponin, etc., often increase in renal failure without any laboratory symptoms, but cardiac troponins are more specific biomarkers for myocardial damage, as it has been shown in recent studies that in more than 70% of patients with end-stage renal failure, cardiac troponins have increased without myocardial damage while there is a significant correlation between increased cardiac troponin level and prediction of adverse outcome in these patients [3].

After the introduction of troponin measurement for the

first time in the early 90s, today these tests would be considered as the first ones in the most of emergency departments [4]. Troponins are composed of a set of three proteins called as troponin I, T, and C, which are present in the cardiac and skeletal muscles [5]. Troponins are not naturally present in the bloodstream. These proteins in the cardiac muscle cells after the death of myocardial cells enter into the bloodstream due to the ischemia. Also, an increase in the level of this substance has been reported in cases of myocardial injury, MI, and chronic myocardial ischemia. Troponin T and troponin I are present only in myocardium of cardiac and skeletal muscle. These two types are easily and quickly released in serum after MI. Troponin I is not even present in the fetal skeletal muscle and does not increase in the serum after damage to the skeletal muscle. Therefore, its increase in serum is clinically important and for the damage to the myocardium is extremely specific [6].

An increase in troponin is not always a sign of MI, it should be considered that other conditions resulting in myocardial damage including myocarditis, heart surgery, angina, and non-cardiac diseases such as renal failure, chronic musculoskeletal disorders and lung embolism can lead to increased troponin levels [3]. As an increase of 17-75% in troponin T has been reported in 4-21% of dialysis patients without any heart disease [7].

An increase in troponins levels with higher cardiovascular risk can lead to higher mortality rate among dialysis patients [8], as shown in a study by Christian et al. on 733 patients that troponin levels are correlated with a significant increase in mortality [9]. Therefore, one of the most recent

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developments that can help predict the mortality in patients undergoing dialysis is the measurement of cardiac troponin levels in these patients. Despite the fact that the levels of troponin T and I are associated with the mortality of patients with end-stage renal failure, but lack of study on patients undergoing dialysis in ICU is felt. Thus, the aim of this study was to determine the association between serum levels of cardiac troponins in patients undergoing dialysis in ICU to predict the mortality of these patients.

Methods

This prospective study included 70 patients in the ICU in Alzahra Training-Medical Center of Isfahan during 2016-17.

The inclusion criteria in the study are admission to ICU, the age over 18 years old, requiring dialysis and consent to participate in the study. Patients were excluded if they were undergoing dialysis before admission to ICU.

Accessible, eligible individuals were randomly assigned and at baseline, demographic data and Apache II scores (within 24 hours) were identified and then serum levels of troponin I and T were determined and recorded in the data collection's form. During the hospitalization period, the mechanical ventilation time and the stay duration in the ICU and the result of treatment including death or improvement were recorded in the patient's profile.

Finally, the collected data was entered into Statistical Package for the Social Sciences (version 20.0; SPSS Inc., Chicago, Ill., USA) and was represented by frequency (percent) or Mean \pm SD. Then analyzed through independent T-test, Chi-square, Fisher's exact test, and ROC analysis. In all analyses, we used the significance level of < 0.05 .

Results

The current study included 70 patients admitted to the ICU [women=29 (41.4%), men= 41 (58.6%), mean age =55.2 \pm 14.1 yrs.] The reason why they were admitted to ICU was Congestive Heart Failure (CHF), Myocardial Infarction

(MI) and stroke respectively, with the prevalence of 17.1%, 15.7% and 14.3%. At the time of their stay in the ICU, 55 (78.6%) patients remained alive and 15 (21.4%) patients died. Also, the mean score of APACHE II (Acute Physiology and Chronic Health Evaluation II) for patients was 23 ± 6.1 with the range of 14-37. According to the standard table of APACHE II, the likelihood of death in four (5.7%) cases is 15% (score 0-15), in 18 (25.7%) cases is 25% (score 16-19), in 19 (27.1%) cases is 40% (score 20-29) and in 11 (15.7%) cases is 75% or more (the score of >30). On the other hand, there was no significant difference between the two results of stay in ICU (alive and dead) in terms of factors such as sex and the cause of hospitalization (P value > 0.05); but, higher age and higher APACHE II score significantly are associated with increased mortality (P value < 0.05) (Table 1).

The mean levels of troponin I and T in these patients were 0.47 ± 0.85 ng / ml and 0.75 ± 1.16 ng / ml, respectively. On the other hand, mean level of troponin I was 0.47 ± 0.11 ng / ml in alive patients and 0.49 ± 0.23 ng / ml in patients who died and the mean level of troponin T in alive and dead patients was 0.67 ± 0.15 ng / ml and 1.06 ± 0.36 ng / ml respectively. There was no significant difference in the mean of both troponin levels between alive and dead patients (Table 2).

On the other hand, Rock analysis also showed that, although the cut-off points of troponin I and T was less than 1.2 ng / ml and more than 1.5 ng / ml, these two biomarkers statistically provided no significant diagnostic value to predict the mortality and they cannot be cited in this respect (P value > 0.05) (Figure 1).

Finally, there was a weak or insignificant correlation between APACHE II scores and troponin I levels (correlation: 0.09; P value = 0.45), but a positive correlation of 0.16 between APACHE II scores and troponin T levels (P value = 0.20).

Table1- The main characteristics of patients in the study

Characteristics	Total (n=70)	Dead(n=15)	Alive(n=55)	P value	
Age; year (Range: 18-79)	55.2 \pm 14.1	62.9 \pm 11.6	54.4 \pm 14.2	0.036	
Sex	Male	29(41.4%)	8/15(53.3%)	47/55(85.5%)	0.290
	Female	41(58.6%)	7/15(46.7%)	8/55(14.5%)	
Cause of hospitalization	CHF	12(17.1%)	3/15(20%)	9/55(16.4%)	0.303
	MI	11(15.7%)	6/15(40%)	5/55(9.1%)	
	Stroke	10(14.3%)	5/15(33.3%)	5/55(9.1%)	
	Other	37(52.9%)	1/15(6.7%)	36/55(65.4%)	
APACHE II	0-15	4(5.7%)	1/15(6.7%)	3/55(5.5%)	0.039
	16-19	18(25.7%)	3/15(20%)	15/55(27.3%)	
	20-30	19(27.1%)	4/15(26.7%)	15/55(27.3%)	
	>30	11(15.7%)	7/15(46.7%)	4/55(7.3%)	

Abbreviations: APACHE II= Acute Physiology and Chronic Health Evaluation II; CHF= Congestive Heart Failure;

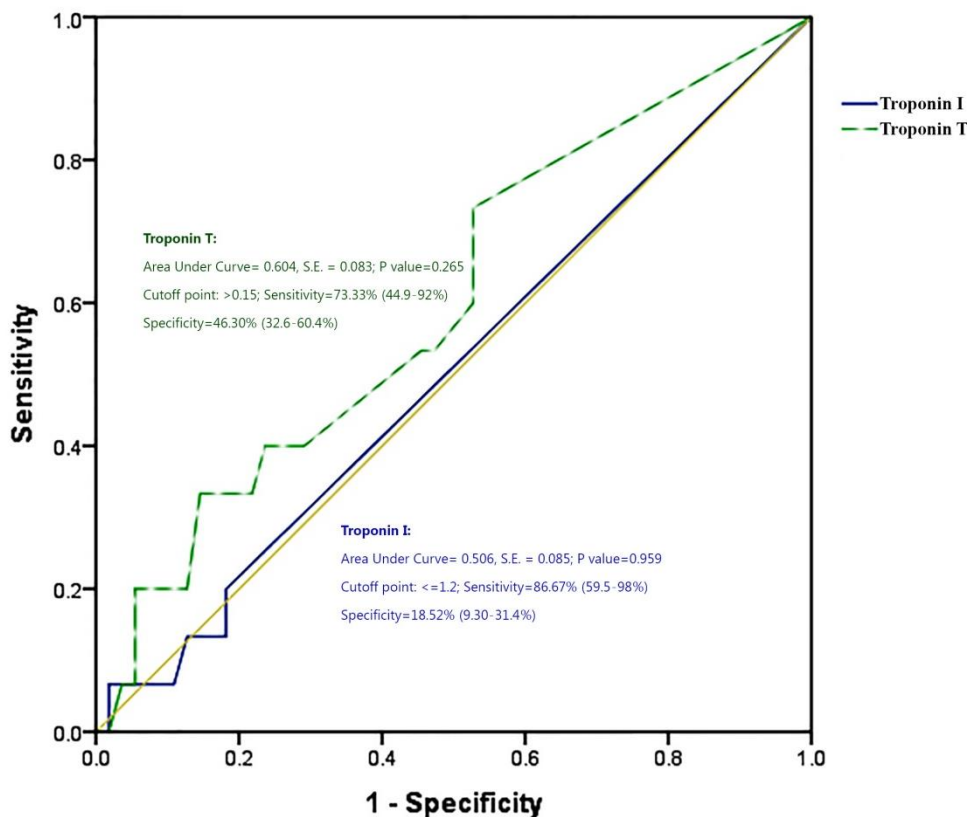
MI= myocardial infarction

Data shown mean \pm SD or n/total (%).

Table 2- Determination and comparison of the levels of troponin I and T in both groups of alive and dead

Troponin	Total (n=70)	Dead(n=15)	Alive(n=55)	P value
Troponin I	0.47±0.85	0.49±0.23	0.47±0.11	0.94
Troponin T	0.75±1.16	1.06±0.36	0.67±0.15	0.25

Data shown mean ± SD.

Figure 1- Rock curve to evaluate the diagnostic value of troponin I and T to predict the mortality

Discussion

Patients who are admitted to ICUs, may undergo dialysis due to impaired renal function. On the other hand, patients undergoing dialysis in ICUs are exposed to higher risk of death than other patients admitted to the ICU, but any marker that could predict the mortality in these patients is not introduced so far. Although troponin proteins are released into the bloodstream during strokes, some studies have shown that the level of these proteins also increases in the blood during an impaired renal function. Therefore, the current study aims to answer this question that whether troponin can be a proper predictor of the death in patients in ICU who are undergoing dialysis or not.

According to the results, 70 patients are included in the study of which 41.4% were women and 58.6% were men, with a mean age of 55.2 ± 14.1 years. At the time of their stay in the ICU, 55 (78.6%) patients remained alive and 15 (21.4%) patients died. Also, the APACHE II criterion showed that the death risk in 15.7% of patients was more than 75%. However there was no significant difference between the alive and dead patients in the mean level of troponin I. Although the mean level of troponin T in dead patients was higher than alive patients, this difference was not statistically significant (P value > 0.05). According to

Rock analysis, the diagnostic value of troponin I and T was insignificant and identified as a poor predictor for the mortality in this respect (P value > 0.05).

Contrary to the current study, Mallamaci et al. (2002) reported a higher troponin T level in patients undergoing hemodialysis, as well as a significant correlation between left ventricular thickness and troponin level. According to their study, troponin T can be a proper predictor of mortality in patients with End-Stage Renal Disease (ESRD). In this study, the mortality of dialysis patients with high levels of troponin T was approximately 2.5 times higher than patients with normal T troponin levels [10]. In the study of Dierkes et al. (2000), the death risk in dialysis patients with a high troponin T levels was 6.85 times higher than those with normal troponin T levels [11]. The results of another study suggested that levels of troponin T and I in the musculoskeletal system of patients with cardiovascular problems were higher than patients without cardiovascular problems, but the level of CK-MB in both groups of with and without cardiovascular problems was not different [12]. Many other studies have demonstrated a lack of correlation between troponin T/I levels and inflammatory factors in renal transplant patients [13-14], or the presence of association between troponin T levels and significant

increases in mortality [9].

According to the results of our study, troponin I and T were not proper predictors for dialysis patients in ICU and these two markers did not have a good sensitivity and specificity to predict the mortality in these patients. While other studies have shown that in patients with end-stage renal disease who are undergoing dialysis the level of troponin is higher and these markers can be a proper predictor of mortality. The reasons why the results of our study differ, are the small sample size as the first one and the inclusion of patients who were admitted to ICUs with not only end-stage renal disease but also mostly with other diseases or causes and due to impaired kidney function requiring dialysis, as the second reason. Therefore, the duration of kidney failure as well as the duration of dialysis, which increases the risk of cardiovascular disease are likely to be the major factors to increase troponin levels in these patients [1,3].

Conclusion

According to the results of our study, troponin I and T are not proper biomarkers to predict the mortality in patients admitted to the ICU for hemodialysis and these markers did not show a proper sensitivity and specificity for this purpose. Therefore, considering the importance of identifying a marker as a good predictor of death in patients undergoing dialysis in the ICU, further studies are recommended in this field.

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