

Troponin I measurement as an indicator of cardiac trauma in patients with severe blunt chest trauma: A prospective study

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Abstract: Background: In patients with blunt chest trauma, blunt cardiac injury (BCI) is not common but a serious injury and difficult to diagnose. Elevated serum Troponin I may suggest myocardial injury. The present prospective study aimed to investigate the diagnostic value of serum Troponin I level in adult patients with severe blunt chest trauma admitted to Sari General Hospital during 2010-2011. **Methods:** Seventy seven patients with severe blunt chest trauma during 2010 - 2011 were enrolled. Echocardiography, ECG, cardiac monitoring and serum troponin I measurement were performed. The patients were divided into two groups. Group I with abnormal ECG and/or echocardiography findings of cardiac trauma, and Group II with normal ECG and echocardiogram and their serum Troponin I level was measured. For data analysis Chi-square and t-test were used. **Results:** Our findings revealed that serum Troponin I measurement has a sensitivity of only 30% and a specificity of 76% for the diagnosis of blunt cardiac trauma. Therefore, serum Troponin I level is not a sensitive and specific diagnostic test for blunt cardiac trauma. It cannot be used as a gold standard test and a normal Troponin I in a trauma patient cannot exclude BCI. **Conclusions:** In conclusion, raised serum Troponin I in a blunt chest trauma patient urges us to perform careful cardiac monitoring and to look seriously for BCI.

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Background:

Trauma is the leading cause of death in 1 to 44 years age group [1]. Approximately 70%-80% of chest injuries are caused by blunt trauma which comprises 20%-25% of death due to trauma. Chest wall, lungs and the intrathoracic organs like aorta, great vessels, thoracic spine and the heart can be damaged during a blunt chest trauma.

Blunt Cardiac Injury (BCI) is not common but a serious injury [2]. The incidence of BCI in blunt chest trauma varies between 20% to 76% of cases. This wide range of reported incidence could be due to the lack of a gold standard diagnostic test for BCI [1, 3].

Cardiac trauma can induce dysrhythmias, conductive defects, cardiogenic shock, hemopericardium, myocardial rupture and cardiac valve injuries [4]. There is no gold standard test for the diagnosis of BCI but serial electrocardiograms (ECGs), echocardiography and cardiac enzymes measurement are used as diagnostic tools [1, 2].

ECG is more sensitive in left heart injuries; on the contrary, the majority of blunt cardiac injuries are on the right side which reduces ECG's diagnostic value [1, 5]. More recent studies have shown that ECG alone is not sufficient to definitively rule out BCI [6]. Persistent tachycardia, ST-T segment changes, ventricular dysrhythmia, heart block, atrial

fibrillation or flutter, and bradycardia are reported in BCI which are not specific to cardiac injuries [1, 2].

Echocardiography can be used as a diagnostic tool in BCI [7]. Wall motion abnormality, chordal rupture, low ejection fraction, valvular dysfunction and hemopericardium can be caused by BCI. Transthoracic echocardiography (TTE) is not technically easy in multiple trauma patients especially in patients with serious chest wall and lung injuries. Transesophageal echocardiography (TEE) is superior to the routine trans-thoracic echocardiography, although an operator dependent and not possible in every trauma center. In addition, performing TEE in patients with head & neck injury is difficult [1, 2, 8, 9].

The serum level of Creatine Kinase-MB (CK-MB) has been introduced as a diagnostic tool for blunt cardiac trauma; it is non-specific especially in patients with severe skeletal muscle, liver, diaphragm or intestinal injury [1]. Troponin -a complex structure of three proteins- lies as thin layers within the striated muscle fibers. Among the troponins, Troponin I is specific for heart muscles and raised serum Troponin I may suggest cardiac muscle injury [2, 10].

The present study aimed to investigate the diagnostic value of serum Troponin I level in adult patients with severe blunt chest trauma admitted to Sari General Hospital in 2010 and 2011.

Material and Methods:

From January 2010 until September 2011, 77 patients of Sari General Hospital were recruited for this study. Inclusion criteria for recruitment were: 1- patients with three or more fractured ribs or 2- sternal fracture or 3- lung contusion or 4- flail chest. In all the multiple trauma patients who met the inclusion criteria, during the resuscitation and emergency procedures, 12-lead ECG and transthoracic echocardiography were performed synchronously and was interpreted by a cardiologist. All patients were monitored concerning cardiac arrhythmia for 48 hours and serum Troponin I was measured 6 hours after admission using VIDAS troponin I ultra assay (Biomerieux, France). Serum Troponin I level of more than 0.01 microgram per liter was the threshold. Trauma severity was scored using Injury Severity Score (ISS) and Reverse Trauma Score (RTS), and also Trauma and Injury Severity Score (TRISS) was used for survival score.

As there is no gold standard test for the diagnosis of cardiac trauma, to evaluate the specificity and sensitivity of raising Troponin I level in cardiac trauma, we divided our patients into two groups: Group I with ECG and/or echocardiography data suggesting cardiac trauma and Group II patients with normal echocardiography and ECG. All data regarding age, ISS, RTS, TRISS and serum Troponin I level were analyzed using SPSS (Version 13). Chi-square and t-test were used. A p-value <0.05 was considered statistically significant. The study was approved by Ethical Research Committee (ERC) of the Mazandaran university of medical sciences.

Results:

Seventy seven patients with severe blunt chest trauma were eligible to enter into our study. The mean age was 47.3 (ranging 20-71), 68 patients were males (% 88.3), and 9 were females (11.7%). Sixty nine patients did not have cardiac event history (89.6%) and 8 patients had a history of heart disease (10.4%). The mean of ISS was 14.15±11.41, and the mean RTS was 7.79±0.18. The mean TRISS was 97.16±6.14.

Nine patients (11.7%) had as an etiology of blunt chest trauma, 16 (20.78%) road accident, 31 (40.25%) motorcycle accident, and 21 (27.27%) car accident. Sixteen patients (20.78%) had fractured sternum, 16 (20.78%) lung contusion, 5 (6.49%) flail chest and all of them had fractured ribs.

In addition to chest trauma, 9 patients (11.7%) had abdominal injuries needed to have emergency laparotomy, 12 (15.58%) with limb injuries for orthopedic interventions, 6 (7.79%) head trauma, and 5 (6.49%) spinal trauma. Chest tube was inserted in 17 patients (22.07%). Table 1 displays Troponin I

level status in patients with injuries other than chest injury.

Fifty two patients had ECG and/or echocardiography evidences suggesting cardiac trauma (among them, 13 patients had echocardiographic evidences). Serum Troponin I was measured in all patients and was higher than normal in 22 cases (28.57%).

In group I which comprised of 52 patients - 16 (20.78%) had raised serum Troponin I level and 36 (46.75%) with normal Troponin I (table 2). In group II with normal ECG and echocardiography, 6 (7.79%) had raised serum Troponin I and 19 (24.68%) in normal levels (table 2).

The two groups were comparable with no statistically significant differences in age, ISS, RTS and TRISS trauma score systems. The sensitivity, specificity, positive predictive value and negative predictive value of raising serum Troponin I for the diagnosis of blunt cardiac trauma are shown in table 3.

Six patients died and refractory cardiogenic shock was the cause of death in three of them. Serum Troponin I was high in 5 of 6 the deceased patients.

Discussion:

Blunt cardiac trauma has a diagnostic burden and with no gold standard measure. Physical examination, cardiac enzyme level, ECG, and echocardiography of the trauma patient are the diagnostic tools. Among them, serum markers are mostly used for the diagnosis of blunt cardiac trauma [1, 2].

Several studies have found Troponin level to be helpful in the diagnosis of cardiac injury. Swaanenburg et al. measured cardiac Troponin I level in 89 blunt trauma patients (chest trauma in 38 patients) at admission and 24h after admission. They concluded that serum Troponin I level can help to identify the group of trauma patients who needs intensive cardiac monitoring. They also concluded that Serum Troponin I level can be normal at admission and may raise 24 hours later [11].

Adams et al. In a prospective study measured serum Troponin I in 44 patients with blunt chest trauma and ECG findings of cardiac contusion. They found serum Troponin I level is 100% sensitive and 97% specific for the diagnosis of blunt cardiac trauma. Therefore, reported serum Troponin I measurement as the most sensitive test for the diagnosis of myocardial contusion [12]. Peter et al. in a prospective study measured venous serum Troponin I level in 36 cases, 25 with and 11 without autopsy evidence of cardiac contusion. They showed a significant elevation in venous serum Troponin I level in cardiac contusion group and concluded that

venous serum Troponin I is a specific marker for the diagnosis of cardiac contusion [13]. In one study, the severe chest trauma patients were evaluated with BCI diagnosed with abnormal ECG result and subcategorized patients based on the magnitude of Troponin I elevation and duration of elevation. The results of this study have determined that the patients with sustained elevations had a greater likelihood of coronary injury, but elevated troponin levels had no prognostic value for BCI [14, 15].

On the other hand, a number of studies did not find troponin level an appropriate indicator of cardiac injury. Bertinchant et al. analysed 94 patients with acute blunt chest trauma and found 26 proved cases of cardiac contusion among them. They measured serum Troponin I level in all 94 patients and found that the test had a sensitivity of 23% with a specificity of 97% [16]. Collins et al. in a prospective evaluation of all blunt trauma patients older than 16 admitted those with possible diagnosis of cardiac contusion, performed ECG and serum troponin

measurement on admission and overnight telemetry. Consequently, they described that an elevated serum troponin is not the definite criteria for the diagnosis of clinically significant cardiac contusion [17].

El-chami et al. in a review article stated that the serum Troponin I measurement is a test with high specificity and low sensitivity for the diagnosis of cardiac blunt trauma. Therefore, they described that serum Troponin I for the evaluation of blunt cardiac injury is helpful, but not definitive. Therefore, they suggested that this test should be used accompanied with other diagnostic tools such as: physical examination, ECG, TTE and TEE [1].

In our study, we measured serum Troponin I level in 77 patients with severe blunt chest trauma. We concluded that serum Troponin I measurement has a sensitivity of only 30% with a specificity of 76% for the diagnosis of blunt cardiac trauma. It also has a 72% positive predictive value and 34% negative predictive value.

Table 1. Troponin I level status in patients with injuries other than chest injury.

	Number of patients (%)	Troponin I positive (%)
Abdominal injuries (laparotomy)	9 (18.37)	2 (28.7)
Extremity injuries (orthopaedic surgery)	12 (24.49)	0
Chest tube insertion	17 (34.7)	3 (42.9)
Head injury	6 (12.24)	1 (14.2)
Spinal injury	5 (10.2)	1 (14.2)
Total	49	7

Table 2. Troponin I level status in two study groups

Troponin I	Group I (%)	Group II (%)
Positive Troponin I	16 (30.76)	6 (24)
Negative Troponin I	36 (69.24)	19 (76)
Total	52	25

Table 3. Predictive values of raised serum Troponin I for the diagnosis of blunt cardiac trauma.

Sensitivity	Specificity	PPV	NPV
30%; CI (0.18-0.45)	76%; CI (0.54-0.90)	72%; CI (0.49-0.89)	34%; CI (0.22-0.48)

CI (95%): confidence interval (95%)

PPV: positive predictive value

NPV: negative predictive value

Conclusions:

We concluded that serum Troponin I level is not a sensitive and diagnostic test for blunt cardiac trauma. It cannot be used as a gold standard test and having a normal Troponin I in a trauma patient cannot exclude blunt cardiac trauma. Raised serum Troponin I in a blunt chest trauma patient urges us to move the patient to an intensive care unit for cardiac monitoring and to look seriously for cardiac contusion.

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