The relationship of trauma severity and mortality with cardiac enzymes and cytokines at multiple trauma patients

Çoklu travmalı olgularda kalp enzimleri ve sitokinler ile travma şiddeti ve mortalitenin ilişkisi

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BACKGROUND

In this study, we aimed to determine the effects of trauma severity on cardiac involvement through evaluating the trauma severity score together with diagnostic tests in multiple trauma patients. A trauma score was determined using various trauma severity scales.

METHODS

After obtaining the approval of the ethics committee of the faculty, this prospective study was performed through evaluating 100 multiple trauma patients, aged over 15 years, who applied to our Emergency Department (ED). After determining the trauma severity score using instruments such as the Injury Severity Score (ISS), Glasgow Coma Scale (GCS), and Revised Trauma Score (RTS), the cardiac condition was evaluated using biochemical and radiological diagnostic tests.

RESULTS

During the study period, 100 patients were evaluated (78 male, 22 female; mean age: 33.2±15.4; range 15 to 70 years). It was determined that 92 (92%) were blunt trauma cases, and 77 (77%) of them were due to traffic accidents. The majority of cases showed electrocardiogram (ECG) abnormalities (63%) and sinus tachycardia (36%). Abnormal echocardiogram (ECHO) findings, mostly accompanied by ventricular defects (n=24), were determined in 31 of the cases. Nineteen cases with high trauma severity score resulted in death, and 14 of all deaths were secondary to traffic accidents. Trauma scores were found to show a significant difference between the two groups.

CONCLUSION

The ISS trauma scale was determined to be the most effective in terms of indicating heart involvement in patients with multiple traumas. Close follow-up and cardiac monitoring should be applied to patients with high trauma severity scores considering possible cardiac rhythm changes and hemodynamic disturbances due to cardiac involvement.

Key Words: Cardiac involvement; cardiac markers; multiple trauma; trauma severity scales.

AMAÇ

Çalışmamızda çeşitli travma şiddet ölçekleriyle zedelenme oranlarını belirlediğimiz çoklu travma hastalarında; bu şiddet oranlarının kalp etkilenimi üzerine etkilerini yardımcı tanı araçları ile birlikte değerlendirerek kıyaslamayı hedefledik.

GEREÇ VE YÖNTEM

İleriye dönük olarak planlanan bu çalışma, fakülte etik kurul onayı alındıktan sonra acil servise başvuran 15 yaşın üzerinde çoklu travmalı 100 hasta değerlendirilerek yapıldı. Hastalarda yaralanma şiddeti ölçeği (ISS), Glaskow koma skalası (GCK), revize edilmiş travma skoru (RTS) gibi travma şiddet ölçekleri kullanılarak travmanın şiddeti belirlendikten sonra, biyokimya ve radyolojik tanı araçlarından faydalanılarak kalp etkilenimi değerlendirildi.

BULGULAR

Çalışma süresince 100 hasta (78 erkek, 22 kadın; ortalama yaş 33; dağılım 15-70 yaş) değerlendirildi. Çoklu travma hastalarının 92'sinin (%92) künt travma, bunlardan da 77'sinin (%77) trafik kazası sonucu olduğu belirlendi. Hastaların %63'ünde çoğunluğu sinüs taşikardisi (%36) olan elektrokardiyogramda (EKG) bozukluğu bulgusu görüldü. Olguların 31'inde çoğunluğunu ventrikül işlev bozukluğunun (n=24) oluşturduğu anormal ekokardiyogram (EKO) bulguları saptandı. Travma şiddeti yüksek olan 19 olgunun 14'ü trafik kazası nedeniyle hayatını kaybetti. İki grup arasında travma skorları istatistiksel olarak anlamlıydı.

SONUÇ

Çoklu travma hastalarında kalp etkilenimini en iyi gösteren travma ölçeğinin ISS olduğu belirlendi. Yüksek travma şiddetine sahip çoklu travmalı hastalara, kalp etkilenimi olabileceği düşünülerek, kalp ritm bozukluğu ve hemodinamik bozukluk açısından kalp monitörizasyonu ve yakın takip yapılmalıdır.

Anahtar Sözcükler: Kalp etkilenimi; kalp belirteçleri; çoklu travma; travma şiddet ölçekleri.

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The term multiple trauma describes trauma-related damage involving multiple body cavities or body parts. Being among the leading causes of death and responsible for high morbidity and mortality rates, multiple traumas constitute an important public health problem.[1] In our country, 111,565 beating cases and 929,304 traffic collisions resulting in death (4228 cases) and injury (183,841 cases) were recorded in 2008.

It is known that one-third of hospitalized cases are due to chest trauma, which is responsible for 20-25% of multiple trauma-related deaths.[1,2] In order to determine and treat cardiac rhythm changes in multiple trauma patients in the early period, frequent examination and close follow-up with cardiac monitoring are of high importance. Troponin T (TnT) and troponin I (TnI) are regarded as the featured indicators in slight cardiac injuries.[3,4] Changes in levels of tumor necrosis factor (TNF)-alpha might be determined due to myocyte damage secondary to cardiac spasm-traumatic cardiac injuries.[5]

Ideal trauma grading systems should target the correct definition of all damage and the severity of each type of damage. Additionally, it should be applicable with acceptable features in trauma centers.

MATERIALS AND METHODS

Multiple trauma patients (n=100) admitted to Cukurova University, Faculty of Medicine, Emergency Department (ED) were included in the scope of this prospective clinical study. Approval of the ethical committee and informed consent of each case were obtained.

During the study period, the total number of patients admitted to Cukurova University ED was 28,033, while the number of all patients with trauma was 1,108 (3.95%). Of these, 100 patients with multiple trauma with involvement of at least two body parts were included in the scope of the study.

In the present study, Injury Severity Score (ISS) and Revised Trauma Score (RTS) were used to determine trauma severity; Glasgow Coma Scale (GCS) was used to determine consciousness. The patients were divided into two groups using critical values of each scale as severe or slight traumatic injury. The critical value for ISS was accepted as 15, for RTS 11, and for GCS 8.

Cardiologic Evaluation

Creatine kinase-MB fraction (CK-MB): Electrochemiluminescence immunoassay (ECLIA) analyzers, Modular Analytics E170 (Elecsys module) and Roche Elecsys 1010/2010 method were used. Normal range was regarded as 0.97-4.94 ng/ml.

CK: Roche/Hitachi: ACN 057 method was used.

Normal values were regarded as <170 U/L.

TnT: Electrochemiluminescence immunoassay (ECLIA) analyzers, Modular Analytics E170 (Elecsys module) and Roche Elecsys 2010 method were used. Normal values were regarded as <0.1 ng/ml.

TNF-alpha: TNF-alpha was studied with Micro Elisa method and Biosorc (Belgium) mark kits. Normal values were regarded as 0.4-3.6 pg/ml.

Echocardiogram (ECHO): The patients were evaluated using ECHO and mobile ECHO Device 3.5 megahertz probe in the Cardiology Laboratory.

Statistical Analysis

In order to analyze the permanent factors, Spearman correlation test and Mann-Whitney U tests were used. While analyzing the categorical factors, chi-square test was used. A p value of <0.05 was accepted as statistically significant. The data was summarized as mean, ± standard deviation (SD) and median (minimum-maximum). Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows package software version 13.0.

RESULTS

During the study period, of 1108 trauma patients admitted to our ED, 829 were male and 279 were female, with a mean age of 32 years and a male/female ratio of 2.9. Of those patients, 100 had multiple traumas. Of these, 78 patients were male and 22 were female, with a male to female ratio of 3.5. Patients' ages ranged between 15 and 70 years, with an average age of 33.2±15.4 years.

Of all cases, 3 patients had previous trauma history while 4 suffered from cardiac failure. Additionally, the medical history of patients revealed that 2 had previous myocardial infarction, 1 had arrhythmia and another had both arrhythmia and cardiac failure. Examining these cases, abnormal electrocardiogram (ECG), CK-MB, CK, and CK-MB/CK were found in 4 patients, ECHO and TnT were abnormal in 3 patients and TNF-alpha was abnormal in 1 patient. The ECG and ECHO results are shown in Table 1.

ECG was abnormal in 63 patients and normal in the remaining 37 patients. The most common finding was sinus tachycardia, followed by right branch block. ST-T wave change, a finding that might indicate myocardial damage, was seen in 10 patients. Of these 10 cases revealing ST-T changes, ECHO revealed abnormal findings in 4 patients (functional defect of ventricles and pericardial effusion); CK-MB levels were abnormal in 7 patients, while TnT and TNF-alpha were abnormal in 4 patients. Furthermore, abnormal CK-MB/CK ratio was detected in all 10 patients.

Examining ECHO results, findings were normal

Table 1. Distribution of abnormal ECG and ECHO findings of patients

Abnormal ECG findings	Number of Patients (n)
Arrhythmia	
Sinus tachycardia	36
Sinus bradycardia	4
Damage of heart muscle	
ST-T wave disorders	10
Conduction system disorders	
Right bundle block	13
Total	63
Abnormal ECHO findings	n
Pleural effusion	2
Pericardial effusion	1
Ventricular wall motion abnormality	20
Pericardial effusion + cardiac muscular laceration	1
Pericardial effusion + left ventricular wall motion abnormality	1
Cardiac valve disorders + left ventricular wall motion abnormality	3
Interventricular septum wall motion abnormality	3
Total	31

Table 2. Accompanying injuries and abnormal findings

Diseases	Number of Patients	Abnormal ECG	Abnormal ECHO	Abnormal TnT	Abnormal CK-MB
Pulmonary contusion	13	12	3	1	5
Hemothorax	3	3	2	2	–
Isolated pneumothorax	1	1	1	–	–
Hemopneumothorax	3	3	1	–	–
Sternum fracture	3	1	3	–	3
Scapula fracture	4	1	1	–	–
Clavicle fractures	8	2	–	–	2
Rib fractures	21	12	13	4	8
1st, 2nd and 3rd rib fractures	9	4	2	1	8
Flail chest	10	4	6	1	5

in 65 patients, and of the remaining, abnormal findings were detected in 31 patients. The most common abnormal finding on ECHO was ventricular function defect. ECG findings were also abnormal in 19 of those 31 cases with abnormal ECHO. Of these 31 cases, CK-MB/CK, CK-MB, TNF-alpha, and TnT were abnormal in 17, 13, 5, and 4 cases, respectively. Furthermore, according to ISS, 16 patients with abnormal ECHO findings were in the severely damaged group.

Of 65 patients with normal ECHO, 37 showed abnormal ECG, 64 had abnormal CK levels, and 60 showed abnormal CK-MB/CK. Abnormal levels of CK-MB, TNF-alpha and TnT were detected in 45, 30 and 5 patients, respectively. The relationship of accompanying injuries and abnormal findings is shown in Table 2.

The relationship between trauma scales and cardiac markers, admission-hospitalization, and discharge periods is shown in Table 3. The hospitalization period was prolonged in parallel to an extended period before presentation to the hospital. A positive correlation was determined between the hospitalization period and ISS, GCS and RTS; with increasing trauma severity, the hospitalization period was also increased. Additionally, ISS increased in conjunction with extending duration before presentation. Evaluating the relationship of cardiac markers and trauma score, it was determined that TnT, CK-MB and CK showed a positive correlation with ISS, while a negative correlation was determined between TnT and RTS. Additionally, a negative correlation was determined between CK-MB and RTS and GCS. Similarly, there was a negative correlation between CK-MB/CK and GCS. However, there was no statistically significant relationship between levels of TNF-alpha and the trauma scales ($p > 0.05$).

Table 3. The correlation coefficient (r) between trauma scales and cardiac markers, admission-hospitalization and discharge period

		CKMB/CK	CK-MB	TnT	TNF	GCS	ISS	RTS	Admission period	Hopitalization period
CK	r	-0.262	0.609	0.186	-0.011	-0.127	0.373	-0.177	0.300	0.379
	p	0.008	0.000	0.064	0.915	0.209	0.000	0.078	0.002	0.000
CKMB/CK	r		0.303	0.164	-0.082	-0.197	0.263	-0.126	-0.096	-0.129
	p		0.002	0.103	0.415	0.049	0.008	0.212	0.340	0.200
CKMB	r			0.402	-0.153	-0.249	0.460	-0.205	0.189	0.247
	p			0.000	0.127	0.013	0.000	0.041	0.060	0.013
TnT	r				-0.121	-0.189	0.405	-0.171	0.209	0.099
	p				0.231	0.060	0.000	0.089	0.037	0.327
TNF	r					0.130	-0.206	0.131	-0.036	-0.133
	p					0.196	0.039	0.194	0.724	0.187
GCS	r						-0.607	0.924	-0.053	-0.279
	p						0.000	0.000	0.598	0.005
ISS	r							-0.548	0.387	0.339
	p							0.000	0.000	0.001
RTS	r								-0.078	-0.291
	p								0.439	0.003
Application	r									0.280
	p									0.005

CK: Creatine inase; CK-MB: Creatine kinase-MB fraction; RTS: Revised Trauma Score; ISS: Injury Severity Score; GCS: Glasgow Coma Scale; TnT: Troponin T.

Evaluating patients according to vital signs during presentation, high fever was present in 1 patient, tachycardia in 75 patients and shock in 10 patients, while 5 patients needed mechanical ventilation. Six of the 10 patients in shock and 4 of 5 mechanically ventilated patients died. It was determined that the CK-MB levels of patients in shock were as follows: Of these, TnT level was high in 1 and abnormal ECHO findings were determined in 2 patients, while other cardiac indicators were normal. CK, CK-MB/CK, CK-MB, TNF-alpha and TnT levels were outside normal range in 93, 90, 70, 40, and 11 cases, respectively (Table 3).

The relationship between vital signs, trauma scores and cardiac injury markers with respect to the prognosis is shown in Table 4. Of 85 patients who underwent a medical intervention at another center, prior to admitting to our department, 19 (22.4%) died; however, none of the patients who transferred directly to our department without any intervention died (p=0.04). Of 24 patients resuscitated at the trauma site, 9 (37.5%) died, while only 10 of 76 patients (13.2%) who had not been resuscitated at the trauma site died (p=0.008). Trauma scores (GCS, ISS, RTS) were found to be significantly different between these two groups. Five (22.7%) of 22 female patients died, while 14 (17.9%) of 78 male patients died (p=0.614). The mean age of exitus cases was 35.9±18.1 years, while the mean age of surviving patients was 32.6±14.8 years (p=0.411).

DISCUSSION

Trauma, one of the most important health problems for our country, commonly affects younger aged individuals and is responsible for considerable physical damage. Approximately 20% of the patients admitted to the ED included patients with chest trauma.[6,7] Traffic collisions are the leading causes of morbidity and mortality worldwide, and a review of the literature revealed that 20% of deaths due to traffic collisions are sourced from trauma-related cardiac injuries.[8,9] In this regard, determining cardiac involvement in traffic collision cases is of high importance to tackle multiple trauma cases and decrease the number of deaths.

Studies aiming to reveal cardiac involvement have been focused mostly on patients with an isolated chest trauma. On the other hand, it has been stated that determining cardiac injuries in multiple trauma cases is a very complex issue.[10]

According to Advanced Trauma Life Support (ATLS), a trauma program of the American College of Surgeons, an accurate diagnosis of cardiac contusions can be established by directly observing the myocardium. A previously conducted study revealed myocardial contusion during autopsy in 14% of deaths due to blunt trauma.[11] In order to diagnose cardiac contusion or other cardiac injuries, tests such as ECG, ECHO, blood levels of CK-MB and CK-MB/CK ratio were used in the present study.

Changes in ECG are non-specific and are not re-

Table 4. The relationship of factors with prognosis*

	Total	Discharge with healing	Death	p
Gender				
Female/Male (n)	22/78	17/64	5/14	0.61
Interventions in other institutions				
No/Yes (n)	15/85	15/66	0/19	0.04
Trauma interventions at site				
No/Yes (n)	76/24	66/15	10/9	0.008
	Mean±SD Med (min-max)	Mean±SD Med (min-max)	Mean±SD Med (min-max)	
Temperature (C°)	36.6±0.6 36.5 (35-39.8)	36.6±0.5 36.5 (36-39.8)	36.6±0.7 36.5 (35-38)	0.828
Pulse (minute)	95.1±19.8 97.0 (44-148)	95.5±19.1 99 (46-130)	93.8±23.4 96 (44-148)	0.532
Systolic blood pressure (mmHg)	124.5±23.4 120 (60-190)	125.5±18.4 120 (75-180)	120.0±39.3 110 (60-90)	0.209
Diastolic blood pressure (mmHg)	77.8±15.5 80 (30-120)	79.4±13.7 80 (55-120)	70.6±20.5 70 (30-110)	0.092
Respiration (minute)	22.1±4.3 20 (5-36)	21.8±4.4 20 (5-36)	23.5±3.3 24 (18-28)	0.079
Pulse oximeter	95.5±7.4 100 (65-100)	96.5±6.6 100 (65-100)	90.9±9.1 92 (70-100)	0.003
CK-MB (ng/ml)	14.3±13.3 9.3 (1.1-56.7)	13.0±12.8 8.1 (1.15-56.7)	19.9±14.2 17.9 (2.5-54.3)	0.030
TnT (ng/ml)	0.053±0.125 0.010 (0.010-0.730)	0.032±0.074 0.010 (0.010-0.400)	0.143±0.226 0.010 (0.010-0.730)	0.001
TNF-alpha (pg/ml)	4.2±10.3 3 (0.3-105)	4.6±11.4 3 (0.3-105)	2.8±1.1 2.6 (1.5-5.2)	0.004
CK (U/L)	1908.7±4543.7 778 (66-39950)	2035.2±4983.1 760 (66-39950)	1369.1±1675.3 836 (79-7547)	0.785
CK-MB/CK	0.013±0.010 0.010 (0.001-0.070)	0.011±0.007 0.010 (0.001-0.040)	0.021±0.014 0.018 (0.005-0.070)	0.001
GCS	12.1±3.8 15 (3-15)	12.9±3.1 15 (5-145)	8.8±4.6 7 (3-15)	0.0001
ISS	28.0±15.0 24 (6-66)	24.9±13.5 22 (6-66)	41.4±14.2 43 (14-66)	0.0001
RTS	7.1±1.2 7.84 (1.46-7.93)	7.3±0.8 7.84 (4.15-7.84)	6.1±1.7 5.96 (1.46-7.93)	0.002

*Intervention during another hospitalization-intervention at trauma site; CK: Creatine inase; CK-MB: Creatine kinase-MB fraction;
RTS: Revised Trauma Score; ISS: Injury Severity Score; GCS: Glasgow Coma Scale; TnT: Troponin T.

garded as a strong indicator for myocardial contusion in trauma cases; however, it might be indicative of cardiac involvement and of certain complications.[12,13]

A meta-analysis by Maenza et al.[14] showed a concordance between important cardiac complications and abnormal ECG findings. It has been reported that every kind of arrhythmia can be diagnosed, while sinus tachycardia, ST-T wave change, ventricular fibrillation, premature atrial and ventricular discharges, atrial fibrillation, and AV blocks have a higher frequency of occurrence and of being diagnosed.[12,14,15]

In our study, abnormal ECG finding was determined in 63 of 100 patients. Of these, sinus tachycardia was detected in 36%, right branch block in 13%, ST-T wave changes in 10%, and sinus bradycardia in 4%. Since ECG changes might be secondary to multiple traumas, the coherency of ECG findings and

cardiac enzymes and ECHO was taken into account for the differential diagnosis of cardiac injuries. ST-T wave changes as an index of cardiac injury was determined in 10 patients. Of these, abnormal ECHO findings (ventricular function disorder and pericardial effusion) were detected in four patients, abnormal CK-MB levels in seven, and abnormal TnT and TNF-alpha in four patients. Furthermore, CK-MB/CK was abnormal in all patients with abnormal ST-T changes. Abnormal ECHO was found in 12 of 36 patients with sinus tachycardia. It was noted that three patients with abnormal ECHO findings died following hospitalization.

A previously conducted study monitoring 68 patients by ECHO, ECG and CK-MB revealed that 49 patients had abnormal findings of any of ECHO, ECG or CK-MB tests.[15]

On the other hand, a statistically significant relationship between ECG changes and ECHO findings was reported in a study dealing with a series of 81 patients by Weiss et al.[16] Abnormal ECHO findings (ventricular function disorders and pleural effusion) were detected in eight of 15 exitus cases.

In the literature, ECHO, ECG findings and cardiac enzymes have been stated to have a high possibility of being abnormal in patients with cardiac injuries secondary to chest trauma.[17,18]

ECHO findings were normal in 65% (n=65) of cases, while abnormal ECHO findings were revealed in 31% (n=31) in the present series. The most common finding was ventricular wall motion abnormality as detected in 20% of cases. In accordance with the literature, abnormal ECG findings were determined in 19 of 31 patients with abnormal ECHO findings. According to ISS, of 31 patients with abnormal ECHO findings, 16 were in the severely damaged group. Thus, ECHO evaluation in the ED of patients with high ISS is of high importance for early diagnosis and treatment.

Since skeletal muscle damage causes an increase in levels of CK-MB, such cases require a differential diagnosis from those cases involving myocardial damage. When evaluating trauma patients to determine the cardiac involvement, it has been stated that CK-MB is increased, and CK-MB/CK rates lower than 2.2% were accepted as abnormal. Furthermore, a correlation between increased CK-MB levels and ECHO, ECG and other cardiac enzymes was reported. Therefore, increased CK-MB is accepted as indicative of cardiac injuries.[19,20]

In our series, CK-MB levels ranged between 1.15-289.0 ng/ml, with an average level of 18.61 ng/ml. CK-MB/CK ratio varied between 0 and 0.7. The CK, CK-MB/CK and CK-MB values were found outside normal range in 93, 90 and 70 patients, respectively. A statistically significant relationship was determined between CK-MB and ISS, TnT, CK, and CK-MB/CK values (p=0.00). A negative correlation was determined between CK-MB and RTS and GCS. In other words, high CK-MB levels were detected in patients with low RTS and GCS. There was no significant relationship between levels of CK-MB and TNF (p=0.18). Additionally, there was a statistically significant relationship between CK-MB/CK and CK-MB, and CK and CK-MB, and ISS as well (p=0.00). Furthermore, in parallel to the delay in presentation to the hospital, CK-MB and CK-MB/CK values were increased with increasing trauma severity and hospitalization duration.

In light of the above-mentioned data, it is important that patients with high severity points on trauma scales be conveyed to an appropriate health center with full facilities providing quick treatment, which might help to decrease the levels of cardiac injury markers.

TnT, a regulatory protein for myocardial contraction, which is released due to myocyte damage, is not released from skeletal muscle. In the literature, TnT is reported to have a higher sensitivity and specificity compared to other cardiac injury markers, and is stated to be more valuable than CK-MB for the purpose of diagnosis.[20,21]

Abnormal TnT values (over 0.1 ng/ml) were detected in 11 patients in our series. Of these, only three patients had a history of cardiac disease. Comparison of TnT with other diagnostic markers revealed that there was a statistically significant relation between CK-MB, ISS and TnT (p=0.00). Furthermore, increase in TnT and CK-MB levels showed a concordance with increased trauma severity scale. Abnormal ECHO findings were determined in four and abnormal ECG was determined in nine of 11 patients with abnormal TnT levels. Use of TnT levels, in addition to the examination of CK-MB, ECHO, ECG, and ISS, was found to be highly valuable in the diagnosis of cardiac injury.

It has been stated that serum TNF levels are increased in circumstances such as blunt trauma, myocardial infarction, cardiopulmonary bypass surgery, congestive cardiac failure, and myocarditis.[22,23] TNF-alpha was used as a supportive diagnostic tool to determine cardiac involvement. It was determined that TNF-alpha levels ranged between 0.3-105 pg/ml, with an average level of 4.2 pg/ml. However, it was not statistically significant (p>0.05) when evaluating the coherence of cardiac injury indicators. Of 40 patients with high TNF-alpha levels, only one had a history of cardiac disease (TNF 5.1 pg/ml). Of these, abnormal ECG was determined in 10 cases and abnormal ECHO in five cases. In the literature, it was stated that TNF-alpha levels increase in the late period of cardiac injuries. Based on this statement, since our cases were evaluated in the acute period, no increase in TNF-alpha levels was determined. Although the diagnostic value of TNF-alpha alone is low, it is valuable as a support for other tests.

Trauma-related researches generally focus on developing and implementing an efficient trauma scoring system through comparing the findings of patients with multiple traumas, which would be useful for patient care. A statistically significant relationship was reported between cardiac contusion and high ISS values (p<0.00).

There was a statistically significant difference in levels of CK-MB and CK between the slight and severe injury groups (p=0.00); however, no significant difference was detected in our series regarding the remaining cardiac injury markers (p>0.05). Abnormal

ECHO was determined in 22 patients while ECG was abnormal in 26 patients in the severely damaged group according to ISS. Increase in the CK-MB level due to multiple traumas, which is specific for cardiac injury, shows the importance of ISS in cardiac injury secondary to multiple traumas. In this regard, the specificity of CK-MB and CK levels to determine cardiac injury severity is higher with ISS than with other trauma scales.

In conclusion, cardiac injury due to multiple trauma, those including chest trauma in particular, is responsible for high morbidity and mortality. ECG remains a sensitive test for diagnosis of blunt cardiac injuries. Especially in the cases with abnormal ECG, evaluating the troponin levels is of high importance for determining increased risk of death. Of cases with blunt chest trauma, those with cardiac disease history, hemodynamic instability, abnormal ECG, high troponin and CK-MB levels, and high trauma severity scores should be followed using intensive cardiac monitoring. Furthermore, those chest trauma patients admitted with chest pain, rib and sternum fractures, and lung damage should also be followed for at least the first 24 hours for blunt cardiac injury. Those patients should additionally be evaluated by ECHO to diagnose and treat possible pericardial tamponade in the early period.

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