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Misunderstood cardiac involvement with heart impairment in traumatic sternal fracture: an enzimatic-guided evaluation

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SUMMARY: **Misunderstood cardiac involvement with heart impairment in traumatic sternal fracture: an enzimatic-guided evaluation.**

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Background. *Isolated sternal fractures occur more and more frequently in traffic road accidents in particular after the introduction of the seat-belt law. This study sets out to assess by laboratory parameters the incidence and consequences of pericardial and myocardial involvement in sternal injury.*

Patients and methods: *Between June 1997 and March 2007, 50 consecutive patients were admitted to our Thoracic Surgical Unit with acute traumatic sternal fractures. X-ray, CT scan, standard 12-lead electrocardiogram (ECG) and echocardiographic evaluation were obtained in all patients. (28 males, 22 females), with displaced and undisplaced fractures. The patients were hospitalised for cardiorespiratory monitoring, pain control and physiotherapy. Oxygen implementation was performed to obtain an arterial saturation above 96%. Supplementary investigations or therapeutic interventions were assessed if clinically indicated.*

Results. *Our data, according to literature, show that sternal trauma must be careful evaluated by monitoring of vital parameters. In our collection we have no mortality with complex comorbidity. The interparametric relation between laboratory values and cardiac involvement was not significant anyway . The prolonged CK-MB peak level in a large number of patients is related with cardiac impairment.*

Conclusions. *Our results suggest that in traumatic sternal fratures enzymatic activity of CK-MB, echocardiographic investigation and careful monitorizing for the first 96 hours are necessary. The cardiac compliance is inadequate in politraumatic patients and can lead to cardiac impairment.*

RIASSUNTO: **Il dosaggio degli enzimi miocardio-specifici nelle fratture sternali come guida alla differenziazione tra coinvolgimento cardiaco secondario al trauma e cardiopatia primitiva.**

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Obiettivo. *Le fratture sternali isolate sono osservabili con relativa frequenza nei traumi della strada, soprattutto dopo l'introduzione delle leggi sulla sicurezza stradale. Lo studio intende valutare, attraverso il dosaggio dei parametri di laboratorio, l'incidenza e le sequele del coinvolgimento miocardico e pericardico nel trauma sternale.*

Pazienti e metodi. *Nel periodo compreso fra giugno 1997 e marzo 2007 sono stati ricoverati, presso la nostra Unità Operativa Complessa di Chirurgia Toracica, 50 pazienti con fratture sternali post-traumatiche. I pazienti (28 maschi e 22 femmine, con fratture sternali composte e scomposte) sono stati sottoposti ad esame radiografico convenzionale e a TC del torace, ad elettrocardiogramma e ad ecocardiografia. Si è ritenuta necessaria l'ospedalizzazione per eseguire il monitoraggio cardiorespiratorio e attuare una terapia analgesica e un supporto fisioterapico adeguati. Un'eventuale ossigenoterapia è stata effettuata allo scopo di ottenere una saturazione di ossigeno pari a circa il 96%. Ulteriori indagini sono state eseguite ove clinicamente indicate.*

Risultati. *I nostri dati, in accordo con la letteratura, mostrano che i traumi sternali devono essere accuratamente valutati attraverso il monitoraggio dei parametri vitali. Nella nostra serie non abbiamo riportato mortalità né complicanze. La relazione interparametrica tra i valori di laboratorio e il grado di coinvolgimento cardiaco non è stata statisticamente significativa. Il prolungato livello di picco della CK-MB è risultato nella maggior parte dei pazienti correlabile al coinvolgimento cardiaco.*

Conclusioni. *I nostri risultati suggeriscono che nelle fratture sternali post-traumatiche lo studio dell'attività enzimatica della CK-MB, la valutazione ecocardiografica e l'attento monitoraggio clinico nelle prime 96 ore dal trauma risultano di indispensabile ausilio.*

KEY WORDS: Sternal fracture - Myocardial enzymes - Sternal osteosynthesis.
Frattura sternale - Enzimi miocardio-specifici - Osteosintesi sternale.

Introduction

Isolated sternal fractures occur more and more frequently in particular in road traffic accidents after the introduction of the seat-belt law. This study sets out to

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assess by laboratory parameters the incidence and consequences of pericardial and myocardial involvement in sternal injury. It was designed as a prospective single centre study of 50 consecutive patients, admitted over a 10 years period with blunt central chest trauma or multiple thoracic injuries. Clinical status, correlated with echocardiograpy, ECG and cardiac enzyme abnormalities were the main outcome measures.

Patients and methods

Between June 1997 and March 2007, 50 consecutive patients were admitted to our Thoracic Surgical Unit with acute traumatic sternal fracture. X-ray, CT scan, standard 12-lead electrocardiogram (ECG) and echocardiographic evaluation were obtained in all patients (28 males, 22 females) (Tables 1, 2 and 3) with displaced or undisplaced sternal fracture (Figs. 1, 2 and 3). The hemodinamical involvement was evaluated by ecocardiographic control in the "golden hour" and again performed during hospitalization as clinical indication.

In all patients we proscribed food intake for at least 36 hours to avoid respiratory overload and anyway until to definite assessment of abdominal injury. The patients were hospitalised for cardiorespiratory monitoring, pain control and physiotherapy. Oxygen implementation was performed to obtain an arterial saturation above 96%. Supplementary investigations or therapeutic interventions were assessed if clinically indicated. In only 5 patient we achieved a thoracostomy with insertion of pleural drainage. Two patients required surgical correction of the "sternal volet" (Fig. 4). Another patient, with aortic traumatic rupture, underwent surgical repair wih endoprosthesis.

In all patients we performed controls of specific laboratory values to detect cardiac involvement by first 48 hours after admission. The laboratory panel included CPK, CK-MB isoenzyme, isoform T of troponin and myoglobinemia. The patient characteristics, mechanism and type of sternal fracture, and associated lesions are summarised in the tables.

TABLE 1 - PATIENTS CHARACTERISTICS.

Male:Female (n)	28:22
Median age, yrs (range)	49 (16-82)

TABLE 2 - MECHANISM OF INJURY.

Road traffic accident (RTA)	29
- seat-belt related RTA	20
- no seat-belt related RTA	9
Domestic injury (fall)	10
Sport injury	6
Other high impact trauma	5
Type of sternal fracture	
- simple or undisplaced	34
- displaced or depressed	16

TABLE 3 - ASSOCIATED LESIONS (IN 27 PATIENTS).

Traumatic brain injury	6
Cervical spine injury	12
Thoracic complications	
- haemothorax	7
- pleural effusion	15
- pericardial effusion	3
- pneumothorax	3
- pneumomediastinum	2
Associated fractures	
- facial bone fracture (orbital)	1
- upper extremities fractures	1
- lower extremities fractures	3
- rib fractures	16
- clavicular fracture	2
- scapular fracture	2

Results

Our data, according to literature (1-7), show that sternal trauma must be evaluated by careful monitoring of vital parameters. In our series we have no mortality with complex comorbidity (Table 3). No racial difference between two groups are observed (p<000.1).

The CK-MB value was normal before 28 hours in all cases (median value 72 hours); 18 (36%) patients showed elevated values of CK-MB within 48 hours, however in 12 patients (24%) this parameter was always normal. The interparametric relation between laboratory values and cardiac involvement was not significant anyway (p = 0.04). The prolonged CK-MB peak level in a large number of patients is related with cardiac impairment (6 patients over 8 with CK-MB long-lasting abnormal value showed a rithm disturbance, i.e. negative T wave).

Two patients were exposed to major surgical procedure (prosthetic aortic replacement and sternal plaques positioning).

Associated lesions may play a role in clinical outcome with prolonged hospital stay, but seem to be not associated with enzymatic CK-MB value (may be CPK parameter in these patients is still elevated).

Conclusions

We can read that "sternal fractures have long been considered associated to cardiac injury", however in

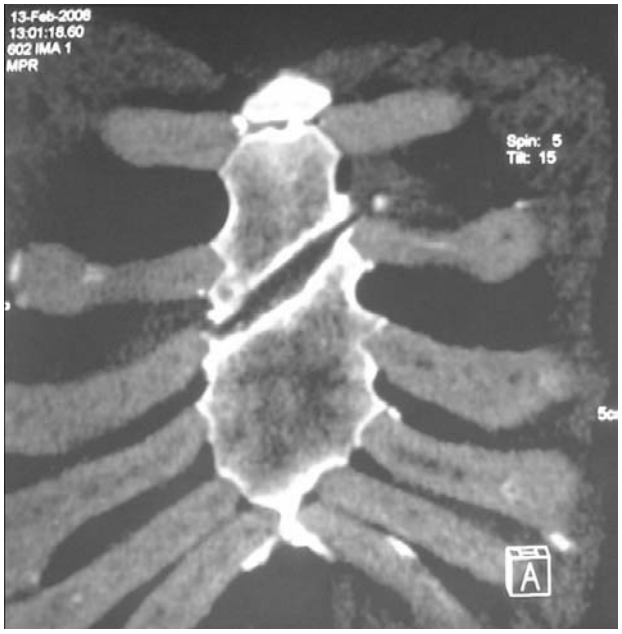

Fig. 1 - Displaced sternal fracture (CT scan).

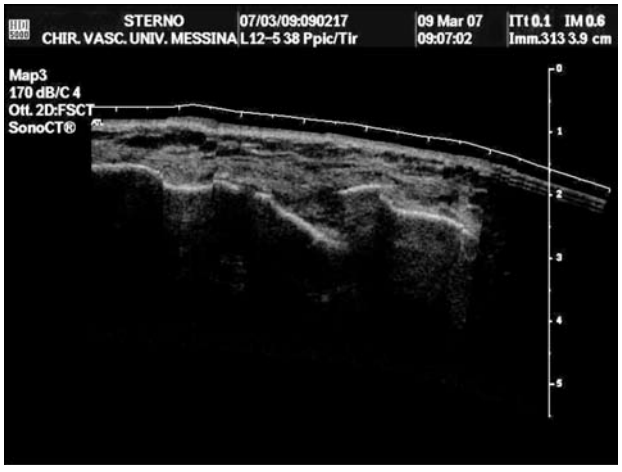

Fig. 2 - Ultrasonographic evaluation of displaced fracture.

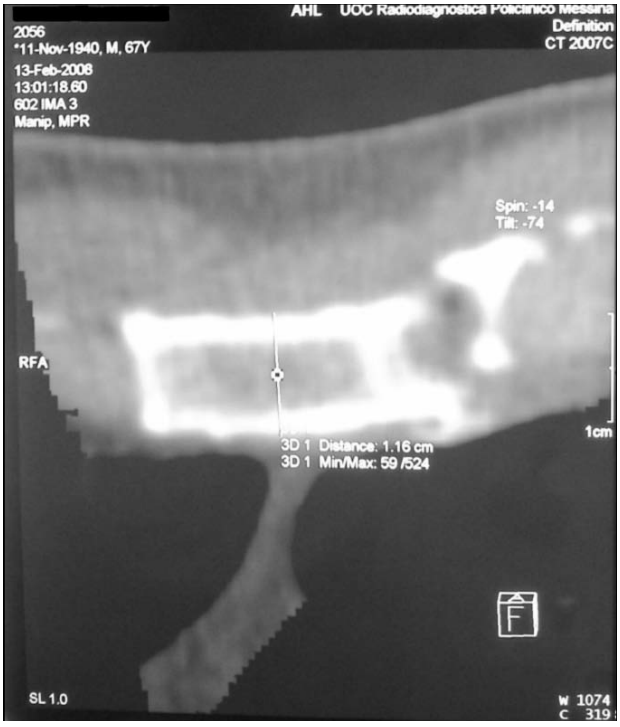

Fig. 3 - CT-evaluation of sternal thickness.

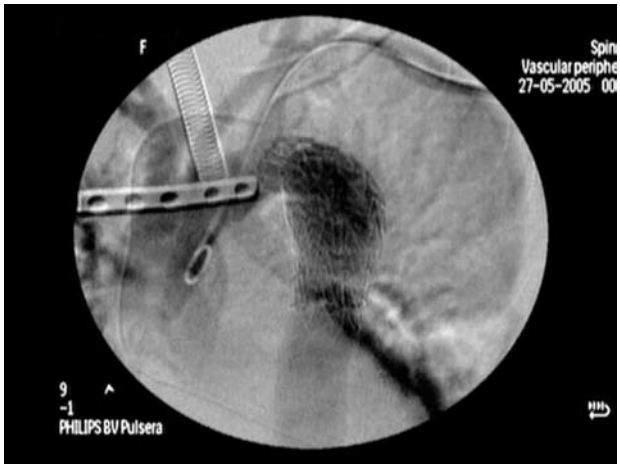

Fig. 4 - Radioscopic evaluation of sternal osteosynthesis.

more cases there is a possibility to identify the patients with a direct cardiac injury and share them from the patients with a traumatic "cardiac recruitment". In a small number of cases many authors describes the echocardiographic appearance of a "diskynetic heart".

One of our patients, suffering a simple sternal fracture showed up the clinical signs of cardiac impairment as long as the laboratoristic changes; in this patient the laboratory values showed a reversal interesting pattern with an abnormal peak of CK-MB and normal CPK and troponine enzymatic activities. In the remaining patients we observed an elevated enzimatic CPK title (39/40=100%) due to traumatic injury. The value of isoenzyme CK-MB was elevated in 28 patients (70%), suggesting cardiac involvement if > 10% of total CPK.

In our series this findings help us to refuse the convinction that all patients with sternal trauma necessarily have a "cardiovascular trauma". Our results suggest that enzymatic activity of CK-MB, the echocardiographic investigation and careful monitorizing in the first 96 hours after sternal trauma is necessary. The cardiac compliance is inadequate in politraumatic patients and can lead to heart impairment.

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