



Original article

Management of isolated sternal fractures: determining the risk of blunt cardiac injury

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A review of the management of isolated sternal fractures in a regional cardiothoracic unit reveals that, in a 2 year period, 37 consecutive patients were admitted for observation and further investigation, including echocardiography and cardiac enzyme measurements to exclude blunt cardiac injury. Minor blunt cardiac injury was detected in only one patient, and was associated with an acutely abnormal electrocardiogram (ECG). ECG showed acute changes in 8 further patients, whilst 3 patients had an abnormal chest X-ray (CXR) due to widening of the mediastinum (1 patient had abnormal CXR and ECG), but none had evidence of cardiac injury. CXR and ECG were both normal in 23 patients, and were predictive of the absence of significant complications. A survey of 22 other cardiothoracic units around the UK confirms that the management of patients with isolated sternal fractures varies considerably from hospital to hospital. As suggested by previous reports, we believe that patients, who are otherwise fit and have normal ECG and CXR on presentation, can be safely discharged home on oral analgesics. The routine use of echocardiography and creatinine kinase (CK) assays in the assessment of isolated sternal fractures is not indicated. The introduction of these guidelines has resulted in a dramatic reduction in the number of patients admitted with isolated sternal fractures to our unit.

Key words: Sternum – Fracture – XR Thorax – Electrocardiography

Isolated sternal fracture may be defined as a sternal fracture without any other thoracic injury such as rib fracture, haemothorax, pneumothorax, *etc.*

Sternal fractures are now seen with increasing frequency in accident and emergency departments, particularly following road traffic accidents (RTA). The incidence of sternal fractures has increased since seat-belt legislation was introduced in 1983.¹

Conventional trauma management suggests that sternal fractures may be associated with serious intra-thoracic injuries, particularly blunt cardiac trauma, and that consideration should be given to admit patients for observation and monitoring. There have been recent reports, however, which have suggested that isolated sternal fracture is a benign injury.²⁻⁹

In this report, we review our management of isolated

sternal fractures over a 2-year period and analyse practices of other cardiothoracic units in the UK. We then examine the effect of the introduction of new guidelines in our unit.

Patients and Methods

A review was done of hospital records of 37 consecutive patients admitted to a cardiothoracic unit, with the diagnosis of isolated sternal fracture, from April 1995 to March 1997 and those of the 6 patients admitted with the same diagnosis, between September 1997 and September 1998.

Questionnaires were sent to consultant cardiothoracic surgeons at 27 units in the UK concerning the management of isolated sternal fractures.

A literature review was performed by Medline search (1987–1997) of publications in the English language relating to isolated sternal fractures and a search was made of papers cited for relevant references.

Results

Review of hospital records

Out of 37 patients (22 female, 15 male) admitted with isolated sternal fracture, 31 (83%) sustained the injury as result of a road traffic accident; all of them were wearing a seatbelt. The remaining were due to a fall from varying heights. Mean age was 49 years (range 16–85 years).

Six patients reported being, or having been, on treatment for respiratory conditions such as chronic obstructive airway disease, asthma, asbestosis and pulmonary embolism. One suffered from osteoporosis. Two patients were known to have pre-existing ischaemic heart disease (IHD), one of them with atrial fibrillation (AF).

The sternal view radiograph revealed that the severity of the fracture ranged from single cortex fracture to full thickness displaced fracture. The location of the fracture varied. Frontal radiograph of chest performed in all patients did not reveal fractured ribs, pneumothorax or haemothorax. All patients were examined to exclude concomitant spinal injury.

ECG was performed in all patients. Echocardiography and CK measurement were performed according to clinical indication or suspicion.

In 28 (75%) patients, no acute abnormality was detected on either chest radiograph or ECG. Echocardiography was carried out in 22 of these patients and

two were found to have small, clinically insignificant, pericardial effusions.

There were 9 patients with acute changes in their ECG. Another 3 had abnormal ECG secondary to previous known conditions (chronic AF, IHD and bundle branch block). Of those with acute changes, 6 had T wave abnormalities in the anterior leads, typically a high take off; one had abnormal Q waves in the inferior leads. One patient had an RSR' pattern and another had AF. Out of these 9 patients, 6 underwent echocardiography, of which 2 showed small pericardial effusions.

Three patients had widening of the mediastinum on CXR and, therefore, underwent aortography, which in all cases ruled out traumatic disruption of the aorta.

Ten (27%) patients had CK levels tested. A CK value of less than 140 IU was considered normal. In 5 patients, the levels were above 140 IU (range 75–1190 IU). Four of these patients underwent echocardiography and only one of them had a small pericardial effusion. His ECG on admission had shown no abnormality. Interestingly, this patient's CK was 1190 IU. He also underwent aortography for a widened mediastinum and this was normal. Only one of these patients with abnormal CK values had acute changes in the ECG.

Out of these 37 patients, only one demonstrated a complication suggestive of blunt cardiac trauma. This was in the form of AF, which was present on admission. Echocardiography showed a minor anterior pericardial effusion.

Patients received paracetamol, dihydrocodeine and non-steroidal anti-inflammatory drugs for pain control. Eight patients (22%) required additional analgesia with injectable morphine sulphate.

Twenty-seven (73%) patients were discharged home within 48 h of admission. Those who remained in hospital longer were due to either other unrelated medical problems or domestic or social difficulties.

During a 12-month period from September 1997, 6 patients with the diagnosis of isolated sternal fracture were admitted to our cardiothoracic unit.

During this year, only one patient presenting with isolated sternal fracture with normal ECG and CXR who was otherwise fit and well was admitted to our unit.

Of the other 5, only one showed acute changes (T wave inversion) on the ECG. In this patient, CK levels raised to 449 IU with a CKMB of 7.3% of the total CK (indication of myocardial infarction if higher than 6%). Echocardiography showed small, non-significant pericardial effusion. In one of these patients, CXR showed widened mediastinum. Aortogram excluded traumatic disruption of the aorta. Another patient suffered from idiopathic thrombocytopenia and one more was

noted to have a systolic murmur when examined in the accident and emergency department. Echocardiography in these three patients failed to show any significant pericardial effusion. The reason for the admission of the fifth patient was history of IHD.

Results of the survey

Questionnaires were sent to consultant cardiothoracic surgeons at 27 centres across the UK. The following information was obtained from the 22 which were returned.

1. In the management of isolated sternal fractures, how often are the following tests performed in your own unit?

See Table 1 for responses

2. Are patients with isolated sternal fractures routinely admitted?

Yes	16 units
No	6 units

3. Any other comments?

The following conclusions can be drawn from the answers to this question:

- In some hospitals, this type of injury is usually managed in the accident and emergency department and the cardiothoracic surgical team is involved only if necessary, e.g. widened mediastinum on X-ray chest.
- In some centres patients are seen by the cardiothoracic team but admitted only if they have a displaced sternal fracture, suspected cardiac injury or poor social circumstances.
- One unit admits these patients routinely but agrees that this is not necessary.

Literature review

Seven publications were identified that reported a series of isolated sternal fractures (see Table 2). In some of

Table 1 Results of the survey: answers to question 1

	Always	Frequently	Seldom	Never
CXR	22	0	0	0
ECG	19	2	1	0
CK levels*	3	6	9	2
Echocardiogram	4	5	11	2

*Two units did not answer this question

them the main subject was isolated sternal fractures,^{2,3} whereas in others these were specified as a subgroup of sternal fractures.^{6,8,9} In two publications,^{5,7} it was not made clear what portion of the cases of sternal fractures were isolated sternal fractures. Nevertheless, the conclusion of both reports referred to the latter.

In total, 649 cases of sternal fractures, of which 423 were identified as isolated sternal fractures, were found (Table 2). None of those patients with isolated sternal fracture who had normal ECG and CXR on admission and had a previous history of respiratory or cardiovascular conditions or had suffered cardiac complications requiring therapy. In all but one of these publications,⁹ the conclusions suggested that isolated sternal fracture is a benign injury and that patients with this condition can be discharged home providing CXR and ECG are normal, and that they are otherwise fit and well

Discussion

Sternal fractures related to road traffic accidents have increased in number over the last two decades. Traditionally, these patients are admitted for observation even if the injury is an isolated sternal fracture. In our experience, none of the 28 patients admitted with this condition who had normal ECG and CXR on admission developed any cardiac or respiratory complication.

There was no clinical or echocardiographic evidence of blunt cardiac injury in any of these 28 patients.

On reviewing the literature, none of 427 patients with isolated sternal fractures, who were otherwise fit and had normal ECG on admission, developed any

Table 2 Publications of series of sternal fractures

Author (year)	Number of patients sternal fractures (isolated sternal fractures)	Cardiac complications requiring treatment	Deaths
Breederveld <i>et al</i> (1988) ⁹	71 (52)	None	None
Jackson & Walker (1992) ²	(104)	None	None
Johnson & Branfoot (1992) ⁵	103 (?)	None	None
Wright (1993) ³	(31)	None	None
Brookes <i>et al</i> (1993) ⁸	(123)	None	None
Heyes & Vincent (1993) ⁷	55 (?)	None	None
Peek & Firmin (1995) ⁶	162 (117)	None	None

complications. None of those who had abnormal ECG or small pericardial effusion developed life-threatening complications during admission.^{2,3,5-8} These reports have shown that isolated sternal injuries are benign in the absence of concomitant cardio-respiratory conditions.

Satisfactory pain control can usually be achieved with oral analgesics such as codeine and NSAIDs. Nevertheless, many centres have continued to admit these patients for observation, investigation and analgesia. The data from our survey should be interpreted with

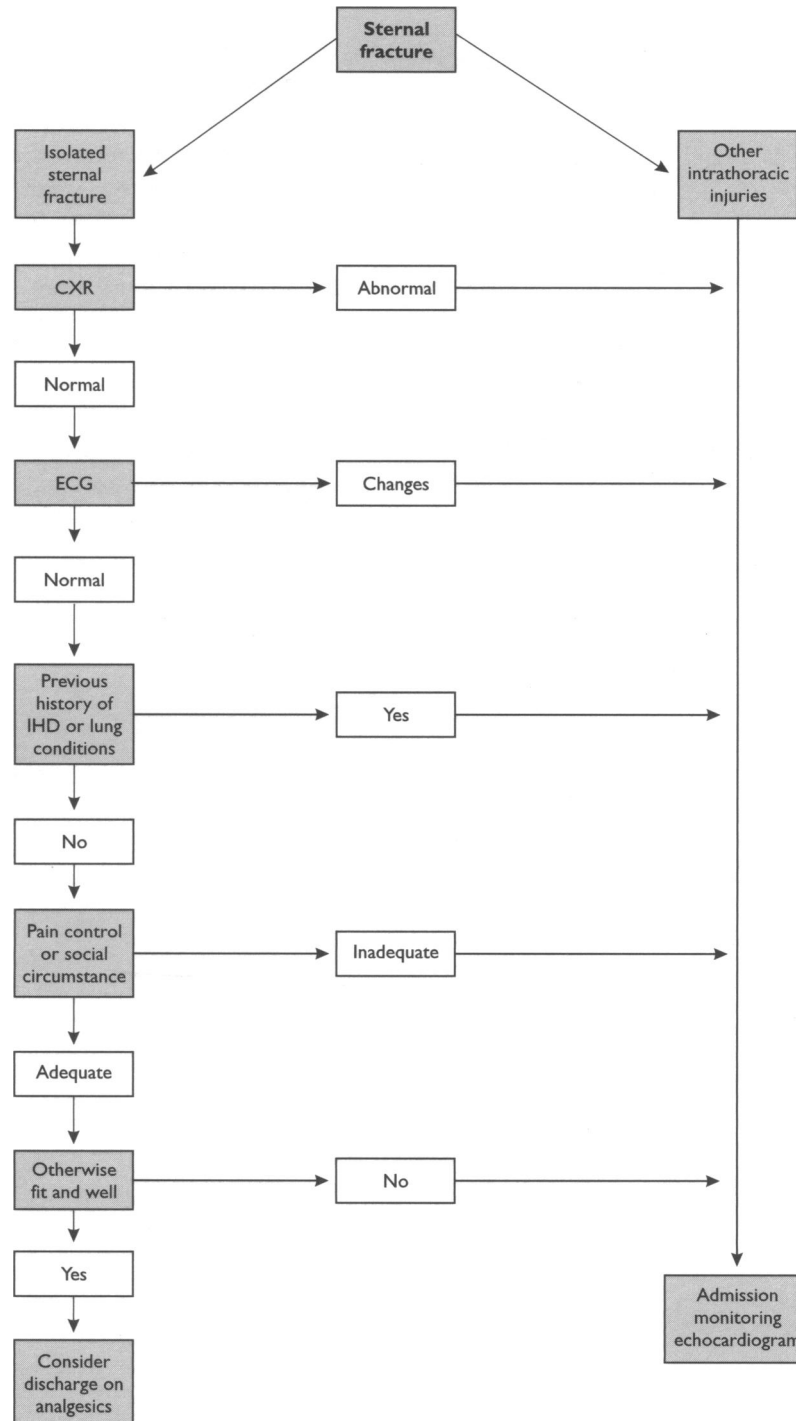


Figure 1 Guidelines for the management of isolated sternal fractures

some caution, as it only reflects general guidelines of management. It can be deduced, however, that the management of isolated sternal fractures in cardiothoracic units in the UK is quite heterogeneous. It is likely, also, that the majority of the isolated sternal fractures are treated outside cardiothoracic units and management protocols may differ further.

Nonetheless, we believe that the information from our own unit, and from the survey of other cardiothoracic units in the UK, shows that a policy of routinely admitting patients with isolated sternal fracture to be unnecessary, as long as sound clinical principles and common sense are applied.

As a result of this study, we have changed the management guidelines for this condition (Fig. 1). Providing they are otherwise fit and well, patients with isolated sternal fracture who have a normal chest X-ray and a normal ECG are discharged home from the accident and emergency department on oral analgesics. Echocardiography is not routinely performed. The patients are admitted only for associated injuries and medical problems.

The introduction of the guidelines for the management of isolated sternal fractures has reduced the workload and bed occupancy in a hard-pressed cardiothoracic unit, and has resulted in important financial savings.

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