

Electrocardiographic abnormalities after blunt chest trauma

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None

Damage to the heart as a result of blunt chest trauma is relatively infrequent, with an incidence of 10% to 16% depending on the series. Nevertheless, damage can cause significant life-threatening events if there is rupture of the cardiac free wall, septa, valves or coronary vessels, or interruption of myocardial circulation and hemodynamic instability. Cardiac contusion most often occurs as a result of blunt chest trauma in a traffic accident, caused by direct chest trauma or acceleration/deceleration forces that affect the heart or, occasionally, the valves. We report a case in which a man taken to our emergency department after a traffic accident developed transient type 2:1 atrioventricular block along with signs of myocardial infarction. The events resolved spontaneously. [Emergencias 2011;23:115-118]

Key words: Electrocardiogram. Blunt chest trauma. Cardiac contusion.

Introduction

Cardiac trauma is currently responsible for a large number of deaths, mainly in young people, and in Spain the major cause of cardiac trauma is road accidents. The incidence of cardiac damage in blunt chest trauma has been estimated at around 10-16%, either by a direct anterior chest trauma or acceleration/deceleration forces that affect the heart or, occasionally, the valves. Suspected diagnosis is based on a set of clinical criteria including significant chest trauma, chest pain, jugular venous distention or a state of shock. Subsequent electrocardiogram (ECG), together with other diagnostic methods, is a key test for supporting the suspicion of cardiac trauma. If clinical and hemodynamic stability allow them, serial enzyme studies performed on admission and every 6-8 hours. But the study par excellence is the ECG, which must be performed on the slightest suspicion of myocardial injury.

The therapeutic approach with this type of patient depends on the hemodynamic status; it ranges from absolute rest, ECG monitoring and

symptomatic treatment, to the use of inotropics, antiarrhythmic drugs or surgery if there is leakage or pericardial tamponade due to heart chamber or coronary artery rupture.

Case report

A 41 year-old man with no relevant medical history was involved in a motorcycle accident which produced multiple injuries, including chest and abdominal injuries. On arrival at the emergency department he was conscious and oriented, presenting left thoracic and upper left quadrant injuries, difficulty breathing and left hemithorax pain. Initial physical examination showed blood pressure (BP) 50/34 mmHg, tachycardia [110 beats per minute (bpm)], tachypnea [40 breaths per minute (rpm)], arterial oxygen saturation 89%, hypoventilation of the left chest and pain in that area as well as the upper left quadrant. Chest X-ray showed multiple rib fractures in the left hemithorax, with clouding of the lower third compatible with hemothorax, without mediastinal

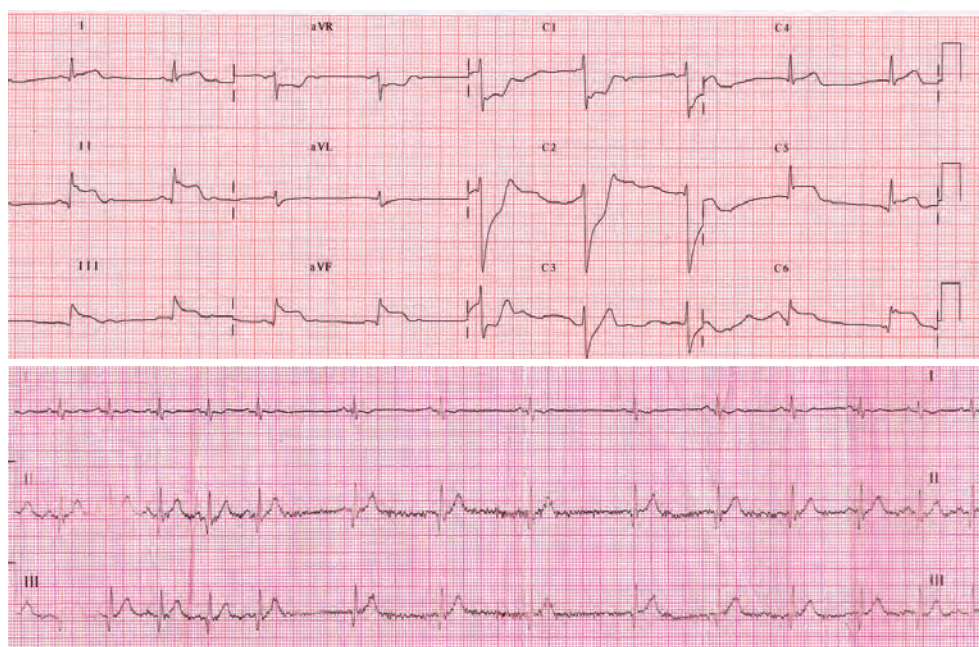


Figure 1. Electrocardiogram 1 (top) showing a 2:1 atrioventricular (AV) block, and diaphragmatic and lateral ST segment elevation. Electrocardiogram 2 (bottom) showing disappearance of the AV block and ST segment elevation, and the presence of sinus arrhythmia.

widening or cardiomegaly. Abdominal ultrasound showed free intraperitoneal fluid, but solid organ rupture or other injuries were not visible. Stabilizing treatment was started with intravenous fluids (colloids and crystalloids) and analgesia; BP of 118/62 mmHg and heart rate of 100 bpm were achieved. A pleural drainage tube placed in the left hemithorax collected approximately 350 cc of bloody fluid, which improved the pain, ventilation and work of breathing.

At the time of ED admission, the patient was hemodynamically unstable and had bradycardia (54 bpm), hypotension (70/40 mmHg) and arterial oxygen saturation 95%. ECG showed a 2/1 atrioventricular block (AVB), together with diffuse ST segment elevation (Figure 1). Given these findings a transcutaneous pacemaker was placed and he was transferred to the intensive care unit (ICU).

During the medicalized ambulance transfer, the AVB and ST elevation were no longer present. He was admitted to the ICU with BP 100/50 mmHg, heart rate 80 bpm and ECG sinus rhythm without ST elevation (Figure 1). The final diagnosis of multiple trauma with multiple rib fractures, left hemopneumothorax, renal laceration, and transitory type 2/1 AVB due to myocardial contusion II of the American Association for the Surgery of Trauma (AAST). The patient was transferred to a ward 10 days of admission, without further complications. The level of creatine kinase (CK)

reached 4,700 U / L with MB fraction 10.4%, and normal troponin levels. Echocardiography showed hypokinesia in the right myocardial region with no evidence of pericardial effusion, and preserved valve integrity and ventricular function. Coronary angiography performed some days later showed no lesions of the coronary artery.

Discussion

The appearance of myocardial contusion after blunt chest trauma is relatively common. However, the clinical criteria for diagnosis remain undefined and there are conflicting reports on the usefulness of different diagnostic tests. There is some evidence that myocardial contusion is more common in major chest trauma accompanying sternal and rib fractures¹.

The AAST, and in particular its Organ Injury Scaling Committee (OIS), in 1994 developed a scale of six levels of severity in cardiac trauma², in order to uniformly describe the different lesions involved (Table 1).

The incidence of cardiac damage in blunt chest trauma is about 10-16%. The main mechanisms are compression of the heart between sternum and spine, or sudden acceleration-deceleration forces. The degree of cardiac injury ranges from myocardial contusion without tissue damage

Table 1. Cardiac injury scaling

Grade I	Closed myocardial injury with minimal abnormalities ECG. Pericardial injury without affecting cardiac tamponade or cardiac herniation.
Grade II	Injury closed with the appearance of heart block or ischemic changes without heart failure. Tangential myocardial injury without extension to endocardium or cardiac tamponade.
Grade III	Injury closed cardiac ventricular extrasystoles multifocal or sustained. Myocardial injury with septal rupture, congestive pulmonary or tricuspid valve dysfunction, muscle papillary or coronary artery occlusion without signs of failure heart. Blunt injury with a torn hernia pericardial heart. Closed heart injury with heart failure. Open wound tangential myocardial involvement endocardial but with tamponade.
Grade IV	Injury cardiac septal rupture, valvular insufficiency pulmonary or tricuspid papillary muscle dysfunction or coronary artery occlusion with signs of heart failure. Cardiac injury with aortic or mitral valve insufficiency. Cardiac injury with right ventricular involvement or one of the atria.
Grade V	Injury heart with occlusion of a coronary artery proximal. Cardiac injury left ventricular perforation. BLI heart with less than 50% loss the right ventricle, right atrium or atrial left.
Grade VI	Avulsion injury closed heart or penetrating wound with loss of more than 50% of your camera. Progress from one grade to the presence of wounds multiple piercing on one or two cavities.

Taken from Moore EE, Malangoni MA, Cogbill TH. Organ Injury Scaling IV: thoracic, vascular, lung, cardiac and diaphragm. *J Trauma*. 1994;36:299-300.

or enzyme elevation to myocardial tissue damage. Myocardial contusion may be the cause of cell damage with electrical and enzyme sequelae, with blood extravasation between myocardial muscle fibers, ending in tissue destruction. Many cases resolve through resorption of the hematoma and scab formation.

Most contusions heal spontaneously but they sometimes leave sequelae such as scarring and aneurysm, and may even generate lethal cardiac arrhythmia, or transient fascicular block, valvular lesions, tears, dissections, or spasms of the coronary arteries which very difficult diagnose. They can cause pericardial effusion with or without cardiac tamponade, but the most common effect is free wall rupture which is usually only diagnosed during autopsy³.

Most cardiac lesions secondary to trauma are seen in the context of multiple injuries, thus being obscured by all the others. The patient may be asymptomatic or have chest pain so easily confused with angina, but with no response to nitroglycerin. Generally, diagnosis is difficult in this scenario, and when cardiac contusion is suspected one must resort to fast, accurate and practical methods in order to correctly diagnose it as soon as possible^{4,5}. The ECG is the initial diagnostic

Table 2. Electrocardiographic findings in cardiac contusion

Nonspecific abnormalities:
– ST Elevation
– QT interval widening
Myocardial injury:
– New Q wave
– ST-segment elevation or depression
Conduction abnormalities:
– Right bundle branch block
– Fascicular block
– AV node conduction impairment (block grade 1, 2 and 3)
Arrhythmias:
– Sinus tachycardia
– Atrial or ventricular effusion
– Atrial fibrillation
– Ventricular tachycardia
– Ventricular fibrillation
– Sinus bradycardia
– Atrial tachycardia

tool, and according to some authors it represents the definitive one to confirm the presence of cardiac contusion. Many electrocardiographic findings have been related with myocardial contusion (Table 2). Among the most frequently found are sinus tachycardia (due to shock), monofocal ventricular extrasystole, transient conduction alterations (mainly right branch block⁶, probably due to increased exposure of the right side), abnormal T wave and ST segment, emergence of a new Q wave, ST changes similar to that in pericarditis or infarction/ischemia due to pericardial or coronary lesions, respectively⁷.

Historically, serum enzyme levels have been used⁸, sometimes with confusing results. For example CK and its MB fraction; in multiple injury patients CK is markedly high and this masks the value of the MB fraction. In recent years, the determination of cardiac troponin T and I has taken on a determinant role in the assessment of early myocardial injury. However, its importance in the diagnosis of myocardial contusion remains to be established⁹. Echocardiography has been a significant advance because it allows the detection of hematomas, aneurysms, fistulas, pericardial effusion, cardiac tissue rupture or global and segmental defects in contractility of the myocardium, relatively frequent in cardiac contusion. Regarding other invasive procedures such as coronary angiography and electrophysiological study, these can be dangerous and difficult to perform in patients in this clinical situation, given their compromised hemodynamic status. Thus when there are findings of impaired conduction, such tests should be postponed until the patient is stabilized or has recovered.

In conclusion, after blunt chest trauma the

most common conduction anomaly is right bundle branch block, and the appearance of post-traumatic complete AV block¹⁰ is exceptional in clinical practice. It may be transient as in our case, or it may be a late complication or persistent, in which case a permanent pacemaker is required.

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Alteraciones electrocardiográficas tras un traumatismo torácico cerrado

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Las lesiones cardíacas resultantes de un traumatismo sobre el corazón representan una afectación no demasiado frecuente (del 10% al 16%, según las series), pero importante por la morbilidad que pueden ocasionar, ya que pueden afectar a la pared libre, al septo, a las válvulas, a las coronarias o al sistema específico de conducción miocárdica y pueden provocar una inestabilidad hemodinámica con compromiso vital para el paciente. En España, la causa más frecuente de traumatismo cardíaco es el secundario al traumatismo torácico sufrido tras un accidente de tráfico, bien por contusión directa en el tórax o por aceleración-deceleración con afectación cardíaca y ocasionalmente valvular. Se describe el caso de un paciente que tras sufrir un accidente de tráfico presentó de manera transitoria un bloqueo auriculoventricular tipo 2/1 junto a semiología característica de infarto inferior, que se resolvió espontáneamente. [Emergencias 2011;23:115-118]

Palabras clave: Electrocardiograma. Trauma torácico cerrado. Contusión cardíaca.