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Case Report

A fatal case of heart and pericardium rupture after non-penetrating chest trauma by road accident

Sara Sablone^{*}, Mara Bellino, Francesco Introna

Section of Legal Medicine, Department of Interdisciplinary Medicine, Bari Policlinico Hospital, University of Bari, 70124 Bari, Italy

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ABSTRACT

Heart lacerations following a non-penetrating chest trauma are rare events, few described in the literature. We report the case of a young woman who died just after a road accident, which determined a blunt thoracic trauma, with perforation of the right ventricle and the contiguous pericardium portion, and compound fractures of the sternum and the left ribs. The case presented is a rare evidence of indirect heart trauma, meaning that there was no correspondence between the chest impact/fracture site and the heart/pericardial lacerations.

Introduction

Blunt cardiac trauma is diagnosed in less than 10 % of trauma patients and covers a range of severity from clinically insignificant myocardial contusions to lethal multi-chamber cardiac ruptures [1,2]. The most common mechanisms of injury include motor vehicle collisions (MVC) (50 %), pedestrians struck by motor vehicles (35 %), motorcycle crashes (9 %), and falls from significant heights [3]. Cardiac injuries are autopsy findings identified in 11.9 % of over 1600 fatalities from blunt trauma; it was either the only cause of death or contributed to the fatal outcome in 45 to 76 % of those cases [3–5]. We present a case report to illustrate this rare diagnosis.

Case description

We report the case of a 36-year-old woman who died because of a road accident while driving her car. Based on preliminary evaluations of the vehicle, it was possible to assume that she had used the seat belts and that the airbag had regularly blown up.

Her cadaver underwent a judicial autopsy aimed at clarifying the cause of death. The external examination only showed a few lesions, such as lacerated and bruised wounds on the face and arms. On palpation, we detected abnormal and preternatural mobility of the left hemithorax.

At chest opening, we detected multilevel and multifocal rib fractures of the left anterior hemithorax, all showing moderate signs of hemorrhagic infiltration.

In addition, we found a full-thickness fracture rhyme of the sternal handlebar.

The right hemithorax was affected by a massive blood pleural effusion (about 2 l), which produced a complete lung collapse (Fig. 1).

The most relevant finding has been appreciated during the examination of the pericardium and heart. Indeed, the pericardial inner surface was blood lacquered. Moreover, its rim's insertion on the right hemidiaphragm showed an oval-shaped laceration surrounded

^{*} Corresponding author.

E-mail address: sara.sablone@policlinico.ba.it (S. Sablone).

by a large area of hemorrhagic infiltration, focally extended to the corresponding convex surface on the right hemidiaphragm (Fig. 2).

The heart also presented an oval transmural laceration of the right ventricle anterior surface, with few signs of hemorrhagic infiltration (Fig. 3). Finally, the epicardial vessels and the inferior vena cava showed a subserosal hemorrhagic infiltration.

Toxicological tests on a blood sample taken from the young woman's body have been then carried out to verify the presence of exogenous substances such as drugs or alcohol. The headspace gas chromatographic method for ethyl alcohol detection and the immunochemical method for methadone, cannabinoids, cocaine, opiates, barbiturates, benzodiazepines, amphetamines, and tricyclic antidepressants detection gave negative results. Therefore, the young woman was not under the influence of the above-mentioned exogenous substances at the moment of the road accident.

In conclusion, the cause of death was hemorrhagic shock from transmural heart laceration with subsequent hemothorax.

Discussion

According to the scientific literature, the possibility of a heart rupture should be considered after a closed chest injury, mainly when an anterior chest trauma with sternal or rib fractures occurs [6–8]. Furthermore, the literature describes heart injuries caused by an impact against the steering wheel column, as well as heart concussion injuries while wearing seat belts [9].

In frontal impact collisions, the mechanism leading to cardiac rupture is usually a crushing force against the steering wheel, with increasing severity depending on vehicle mass and velocity [9].

Traditionally, blunt cardiac rupture with an intact pericardium presents with signs and symptoms of cardiac tamponade. Instead, cardiac rupture with torn pericardium presents with mediastinum's hemorrhage or hemothorax [10].

Overall, a better prognosis has been reported for blunt traumatic atrial tears rather than ventricular ruptures [5,11,12].

Anyway, blunt traumatic ruptures of the heart and pericardium carry a high mortality rate. The National Trauma Data Bank reports that chamber ruptures represent 0.041 % of all trauma cases and have an overall mortality rate of 89.2 % [13]. A retrospective review of more than 20,000 patients admitted from 1979 to 1989 to a single Level I trauma center identified an overall mortality rate of 76 % (45 patients) [13]. Furthermore, in a review of 4169 victims of traffic collisions fatally injured between 1972 and 1985, chest injuries were recorded as the root cause of death in 1121 victims [13]. Despite wearing a seatbelt, 75 out of 207 patients were found to have cardiac rupture on autopsy [13].

The case here presented confirms that it is possible, although rare, to have one or more heart chambers rupture even with indirect injuries, without the need for direct compression of the heart and in the absence of “obvious” or penetrating chest injuries. Indeed, almost paradoxically, several not-displaced rib fractures were found in the cadaver's left hemithorax, while the right heart and pericardium surface was affected by lacerations.

Generally, the ruptures of the ventricular chamber are more frequent than the atrial ones, and among these, the incidence of left atrium ruptures is lower [14]. However, in all these cases, there is no evidence of a clear correlation between the chest trauma site and the cardiac/pericardial injury [14].

In 70 % of the blunt-force injury cases with cardiac rupture, the pericardium remains intact; in 30 % of cases, it breaks because of increased intraabdominal pressure or decelerative lateral forces on both sides [15]. Due to pericardial rupture, patients may bleed in



Fig. 1. Right hemithorax with collapsed right lung after the evacuation of massive blood pleural effusion.

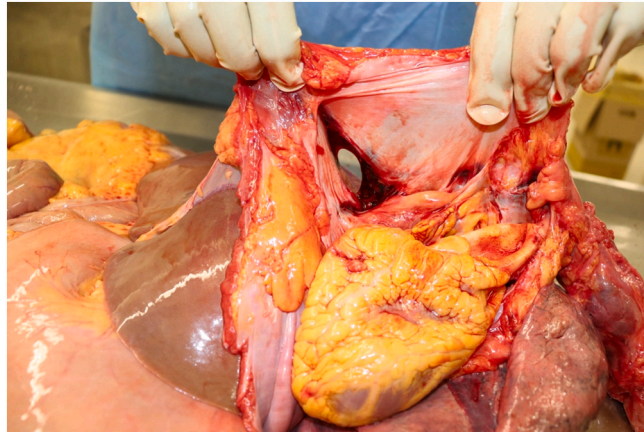


Fig. 2. Blood lacquered pericardium inner surface with the oval-shaped laceration of its insertion rim on the right hemidiaphragm.



Fig. 3. The oval transmurular laceration of the right ventricle.

the mediastinum or pleural cavity, just as happened in the case here described.

We have thus reported a very singular case, firstly for the indirect mechanism of cardiac rupture and secondly for the infrequent occurrence of pericardial laceration.

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CRediT authorship contribution statement

Conceptualization, S.S.; methodology, S.S.; software, S.S. and M.B.; validation, S.S., and F.I.; formal analysis, S.S.; investigation, S.S.; resources, S.S. and F.I.; data curation, S.S. and M.B.; writing—original draft preparation, S.S. and M.B.; writing—review and editing, S.S.; supervision, S.S. and F.I.; project administration, S.S.; funding acquisition, S.S. and F.I. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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