Cardiac Rupture Following Blunt Chest Trauma: The Case Of A High Semi-Truck

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Citation

Abstract
Blunt cardiac ruptures most commonly follow road traffic accidents and have a high mortality rate. This is the case of a truck driver who lost his life following a fatal accident involving his semi truck and a low viaduct. The driver did not have his seat belt fastened and was going at about 70km/h. His truck was wedged under the bridge by its rear causing his fatality. The autopsy found a rupture of the right ventricle and bruises of the right lung associated with fractures of the sternum and ribs. Histological examination revealed myxoid degeneration of the mitral valve which could be involved in this road accident. The circumstances of this accident and histological findings make for a strong case of the medicolegal diagnosis of a brutal deceleration and of a direct chest trauma.

INTRODUCTION
Blunt cardiac rupture is likely to remain an injury that is rarely survivable. Their frequency in the series of autopsies is very variable but still remains high notably when they occur during a road traffic accident where the cardiac rupture is rarely isolated (1, 3). Blunt cardiac rupture accounts for an estimated 5% of the yearly deaths attributed to motor vehicle accidents (1).

We present a postmortem finding of cardiac rupture with sternal and ribs fractures following an unusual road traffic accident. We discuss the production mechanisms of the injuries.

CASE REPORT
In June 2005, a 36-year old truck driver lost his life following a fatal accident involving his semi truck and a low viaduct. He did not have his seat belt fastened and was traveling at about 70km/h. His truck was wedged under the bridge by its rear causing his fatality (Fig. 1-2). There were no skid marks on the road and the truck was slightly veered to the left side of the road. The delay between the accident and the death was one hour and five minutes. Resuscitation - without cardiac massage - was applied at the scene of the accident but he expired quickly. The autopsy was performed within the twenty-four hours.

Figure 1
Figure 1 & 2: The truck is wedged under the bridge by its rear.
External examination found a cyanosis, marks of resuscitation (points of jugular and sub-clavicular punctures at the left side), an important bruise on the average third of the previous face and median of the chest. There was no head injury.

The autopsy examination revealed a 2.2 cm myocardial laceration on the anterioinferior portion of the right ventricle (Fig. 3) with a total of 450 cc of clotted blood in the pericardial cavity but there was no tear of the pericardium. There were additional injuries: fracture average third of the sternum as well as stable fractures of ribs (the third rib on the right side and the fourth rib on the left side), right lung contusion with profuse hemothorax in the form of hematic fluid (850 cc) into the right thoracic cavity. The coronary arteries, the thoracic aorta and oesophagus were normal.

At the abdomen level, the examination noted a hemorrhagic infiltration into the fascia of the right colon. The liver and the other organs did not present any traumatic injury.

There were no brain injuries and no fracture of the cranium and the spine.

Histopathological study confirmed the laceration of the myocardium at the right ventricle level with the presence of cellular damages and inflammatory cells which showed its antemortem nature (Fig. 4). There were no microscopic lesions of acute myocardial infarction or scar tissue to the heart inspection. This microscopic examination has also revealed a dissociation of the mitral valvular wall by myxoid substance (Fig. 5). At the lungs level, it showed lesions compatible with a mitral lung (Fig. 6).

Figure 3
Figure 3: The myocardial laceration of the right ventricle.

Figure 4
Figure 4: Hemorrhagic laceration of the heart associated with polymorphous inflammatory cells and cellular distress signs. HES G x 400
Figure 5
Figure 5: Dissociation of the mitral valvular wall due to myxoid substance. HES G x 10

Figure 6
Figure 6: Macrophagic alveolitis with numerous siderophages and fibroid changes of the alveolar wall. PERLS G x 200

We concluded that death was in relation with a cardiac tamponade due to rupture of the right ventricle. The combination of sternal and ribs fractures and right lung contusion allowed to discuss the implication of a combined mechanism in these injuries. In addition, histological examination findings allowed bringing back the involvement of the driver's previous state in the occurrence of the road accident. Indeed, myxoid degeneration of the mitral valve was not asymptomatic because this man presented a mitral lung.

DISCUSSION
Cardiac injury most commonly occurs in road traffic accidents (2, 4) followed by direct blows to the chest (5), falls from heights (6), sporting (7) and industrial injuries (8). Myocardial contusion due to traumatic coronary occlusion is the most common form of cardiac injury caused by blunt chest trauma (4, 9, 10). However, cardiac rupture has most often been documented in this type of trauma notably in road accident, particulary motor vehicle collision (11, 12).

Our study presents the case of a truck wedged under a bridge by its rear. There were unusual circumstances to the accident where the truck driver was found dead at the scene. Indeed, about 80 to 90% of victims with cardiac rupture die almost immediately before any admission to the hospital (13). This fact seems to be connected with the localisation of the injury to the heart. The greatest mortality rate occurs when there is a ventricular rupture (14). Our case confirms this observation because the victim died quickly from a rupture of the right ventricle. According to Keith Mant (15), the right atrium is the chamber most frequently ruptured, followed by the right ventricle. Rupture of the left ventricle is rarer than tears to the right ventricle or atra (16, 17). Out of the ventricular ruptures, injuries to the pericardium, coronary arteries, valves and aorta have also been documented in literature (1, 2, 7, 16).

In the Türk's serie (18), although it was the pericardial tears that predominated (45%) among heart injuries following falls from height, rupture of the right ventricle (39%) was also most frequent than tear of the left ventricle (9%). Furthermore, if the pericardium is intact when rupture occurs, tamponade contributes significantly to the fatal outcome (19, 17) such as occurred in our case.

In the presence of a cardiac rupture, we must take into account previous history of heart disease because the common etiology of cardiac rupture is acute myocardial infarction (16). It is also possible that a healed myocardial incision may be broken with blunt mechanical forces (19). In our case report, it was important to look for these pathologies because they could be a previous state in the accidental occurrence. The histological examination did not reveal obvious abnormality of myocardium (ischemia or scar tissue). But it found out a myxoid degeneration of the valve mitral (Barlow disease). Almost always a myxoid degeneration of the valve is the base of a mitral valve prolapse (19, 20) which is involved in the sudden death (21, 22). This valvular disease generate non specific symptoms (as dizziness, syncope, asthenia, chest-pain...) and arrhythmias (23). However, deaths due to mitral valve prolapse are
uncommon. Diagnosis of this disease as a cause of death must be made by exclusion due to its prevalence in the general population (1). We think that the driver felt faint at the steering wheel and that caused the road accident. The arguments for this hypothesis are the existence of myxoid degeneration of the mitral valve, the absence of skid marks on the road, and the slightly swerve of the truck on the left.

The autopsy has found other accompanying injuries: sternal and ribs fractures, right lung contusion and right hemothorax. These associated injuries are often described in blunt chest trauma (23, 24, 25) and in one case, acute ascites was noted (26). Sternal fractures were particularly studied with blunt cardiac injuries (27). Despite the fact that there was no correlation between the presence of sternal fracture and the type of heart injuries in the Türk’s study (2), this fracture was frequently observed with blunt chest trauma and this so much more than there were multiple fractures.

Several mechanisms for blunt chest trauma have been proposed to explain the injuries (2, 4, 26, 27, 28). Our autopsy findings are interesting to understand the mechanisms, which intervene in these unusual accidental circumstances. We have considered two types of mechanisms:

1. direct mechanism represented by a blow to the front part of the chest. Indeed, the truck driver was propelled forward, his chest against the steering wheel, since he was not wearing his seat belt at the time of the accident. The impact was particularly violent because the steering wheel was bent and the victim presented a bruise in the middle of the chest abutting the sternal fracture and also some ribs fractures. This violent, direct and sudden compression of the heart is known as the most common cause of ventricular rupture probably during the end of the diastole that is when the ventricle is distended with blood (27, 28). This explains the obvious hemopericardium notably when the pericardium is intact. We believe that in our autopsy case, direct mechanism was dominant. The other accompanying injuries that we have observed support our analysis of direct mechanism. However, penetration from broken ribs or sternal fragments is not a mechanism to envisage in our case because theses fractures were stable. On the other hand, we observed a contusion on the right lung, which was accompanied by a profuse right hemothorax. This could have been a factor in the fatal outcome (27).

2. indirect mechanism is the sudden deceleration produced by the abrupt stop of the rear of the truck under the bridge. This, with the heart compression between the sternum and the spine, resulting in intense changes in intrathoracic and intracardiac pressure during sudden deceleration (9). Deceleration was probably involved in these circumstances but it was not the direct cause because the more common thoracic injury associated with deceleration in traffic accidents is the ruptured aorta (16). Furthermore, we have not observed pericardial tear while this injury occurs readily when there is a rapid increase in intracardiac pressure like in falls from heights (17). Finally, the wearing of seat belt does not seem to prevent cardiac rupture (18). This is in agreement with the fact that deceleration is the dominant factor in the occurrence of a tear rather than a myocardial contusion (19).

CONCLUSION

This autopsy report shows that cardiac rupture may be occurring outside significant motor vehicle collision. A truck wedged under the bridge because the viaduct is low may be a fatal accident. The coexisting ventricular rupture and sternal and ribs fractures indicate that direct and indirect mechanisms were combined but the former seems dominant. There is a high mortality risk associated with right ventricular rupture following blunt chest trauma and resultant tamponade. However, there are many cases of patients with cardiac rupture from blunt trauma who have been successfully diagnosed and discussed (2, 11, 12, 20). In addition, our case report emphasizes the interest to associate histopathological examination with autopsy. In our case, histological examination revealed myxoid degeneration of the mitral valve (Barlow disease) which could be involved in this road accident.

References

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