



Pathology/Biology Section - 2015

H141 Myocardial Rupture and Cardiopulmonary Resuscitation: Diagnosis and Forensic Issues

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After attending this presentation, attendees will better understand traumatic, particularly myocardial, injuries due to Cardiopulmonary Resuscitation (CPR).

This presentation will impact the forensic science community by helping differentiate traumatic myocardial rupture due to CPR from other causes of rupture such as myocardial infarction and by recognizing risk factors of heart injuries due to CPR.

Chest compression is the main component of CPR and provides minimal blood flow despite cardiac arrest. Since the 1960s, skeletal injuries related to chest compression have been described, in particular, sternum and anterior rib fractures. They are frequent (in 25%-30% of patients) but are usually not fatal. To the contrary, visceral injuries such as lung contusions, heart or hepatic hematomas or ruptures, and splenic ruptures due to CPR are uncommon but may lead to the death of the victim.

Heart rupture, which is a particular autopsy finding, raises several questions: (1) is the heart rupture traumatic due to blunt force trauma or non-traumatic due to a pre-existing cardiovascular condition (e.g. cardiac infarction or myocarditis); (2) if the rupture is traumatic, what kind of mechanism may be involved? In cases of chest trauma, are the lesions due to CPR or to the initial injuries; and, (3) is death due to the primary cause of cardiac arrest or due to the CPR-related heart injury? In order to illustrate and delve more deeply into this matter, this study will present five cases of heart ruptures after CPR. The cases that will be presented include three women aged 35, 34, and 48 years old (Cases 2, 3, and 5), and two men aged 29 and 23 years old (Cases 1 and 5). The three women were underweight (Cases 2, 3, and 5); in two cases, the body weight was within normal range. Cases 1 and 4 had unexplained syncope in the presence of witnesses, whereas Case 5 lost consciousness after facial trauma in front of his assailant. In Cases 2 and 3, the women were found hanged by their partners. CPR was undertaken by medical emergency teams and initially by laypersons in Cases 3 and 5.

Autopsies found right atrium rupture in Case 3, right ventricle rupture in Cases 1 and 2, and left ventricle rupture in Cases 4 and 5. These ruptures were associated with hematoma of the left atrium in Cases 2 and 3, with hematomas of the aortic arch in Cases 4 and 5, of the pulmonary hilum in Cases 2, 4, and 5, of left interlobar fissure in Case 5, and of the descending thoracic aorta in Case 4.

Hemopericardium of variable volume from 50-300ml was found in all cases. Hemothorax less than 100ml was found in Cases 4 and 5. There was no case of lacerations of the pericardium. Two cases (2 and 4) had pericardium hematoma. Four cases presented with anterior or anterolateral rib and sternum fractures. A 70% coronary stenosis was found in Case 4, but without thrombosis or myocardial infarction. Facial bruises with nasal fracture were found in Case 5, but there were no brain injuries.

Microscopic analyses (Cases 1, 2, and 5) did not find cardiovascular pre-existing pathology and concluded that lacerations of the right ventricle (Cases 1 and 2) were postmortem. In Cases 1 to 4, cardiac and mediastinal injuries were found to be related to chest compression during CPR. In Case 5, hemorrhagic infiltrates and myocardial fibers in contraction were found microscopically in the samples of the left ventricle. These observations suggested antemortem injuries due to chest compressions on a still-beating heart.

In conclusion, the probability of CPR-related myocardial rupture is high when associated with sternum and/or rib fractures, when chest compression could be only explained by CPR, and when there is no pre-existing cardiovascular disease. Risk factors are low body weight of the victim, CPR initiated by laypersons, and maneuvers of long duration.

Cardiopulmonary Resuscitation, Heart Rupture, Hemopericardium