

H32 Non-Skeletal Injuries Related to Cardiopulmonary Resuscitation (CPR): An Autopsy Study

*Fabiola Righi, DO**, Mayo Clinic, Rochester, MN 55905; *Peter T. Lin, MD*, Mayo Clinic, Rochester, MN 55905

Learning Overview: After attending this presentation, attendees will better understand the range and severity of non-skeletal injuries associated with CPR.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by contributing additional information relating to injuries from CPR and improving the knowledge and tools necessary to differentiate medical intervention-related injuries from other injuries in the forensic autopsy setting.

The current standard technique for CPR, initially described in the early 1960s, has quickly become the expected response for all persons found without a pulse or respiration. External cardiac massage stands as the mainstay of therapy with the goal of producing blood movement, leading to a temporary circulation that achieves adequate oxygenation of terminal vessels by raising intrathoracic pressure, until Return Of Spontaneous Circulation (ROSC) is achieved. In spite of its potentially lifesaving properties, external cardiac massage consists of repeated blunt force trauma to the chest, which can lead to extensive traumatic skeletal injuries. Once the stability of the bony skeleton has been compromised, visceral injuries may also occur. Numerous autopsy-based studies have documented the incidence and patterns of rib and sternal fractures associated with attempted CPR, but there is relatively little data on the incidence and severity of non-skeletal CPR-related injuries. Both skeletal and non-skeletal CPR-related injuries can be difficult to distinguish from traumatic injuries that were present prior to the onset of CPR. Therefore, it is helpful for forensic pathologists to understand the types and severity of non-skeletal injuries that may be associated with CPR.

In order to contribute additional knowledge to this area, 1,878 autopsy reports between the years of 2017 and 2019 were retrospectively searched for documentation of CPR-related injuries. Both hospital and forensic autopsies were included. Among the 1,878 autopsies performed within this time frame, 338 cases had CPR-related injuries documented in the autopsy report. Of these 338 autopsies with either skeletal or non-skeletal CPR-related injury, 28% ($n=93$) had a non-skeletal, visceral injury documented at autopsy. Conversely, 1.5% had visceral injuries without skeletal injury. The average age for non-skeletal injuries was 60.3 years and there was a slight male predominance with a male-to-female ratio of 1.27. The three most common causes of death were cardiovascular diseases (49%), substance abuse (11%), and trauma (8%). In ten cases (10.7%), a LUCAS[®] device had been used to perform resuscitation.

Out of the total number of cases with reported injuries, hemothoraces were present in 9.5% of cases, with most cases having bilateral collections averaging 441ml of blood on the right and 638ml on the left side of the chest (range: 10–3,150ml). Hemopericardium was documented in 2.7% of cases, with an average of 117ml of blood collected during the autopsy (range: 30–200ml).

Visceral contusions were the most common type of non-skeletal CPR-related injury, documented in 21.3% of cases, predominantly involving the heart and lungs, closely followed by contusions of the neck soft tissue and surrounding structures. Sixteen cases (4.7%) had visceral lacerations involving the pericardium ($n=7$), heart ($n=3$), aorta ($n=1$), liver ($n=4$), and esophagus ($n=1$). The esophageal laceration resulted from perforation by a King airway tube. Lung lacerations were not observed.

The goal of this study is to provide additional documentation on the range and severity of various types of resuscitation-related visceral injuries. Based on this study's data, the most common non-skeletal injuries are contusions of the heart, lungs, and soft tissues. Rare injuries include lacerations of the pericardium, heart, aorta, liver, and esophagus.

A limitation of this study is that the number of decedents who received CPR among the 1,878 searched cases could not be determined due to inconsistent documentation of clinical information in the autopsy report. Therefore, the incidence of these injuries resulting from CPR could not be determined.

Forensic Autopsy, Cardiopulmonary Resuscitation, CPR