

CASE REPORT

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Cardiac Laceration and Pericardial Tamponade Due to Cardiopulmonary Resuscitation After Myocardial Infarction

REFERENCE: Noffsinger, A. E., Blisard, K. S., and Balko, M. G., "Cardiac Laceration and Pericardial Tamponade Due to Cardiopulmonary Resuscitation After Myocardial Infarction," *Journal of Forensic Sciences*, JFSCA, Vol. 36, No. 6, Nov. 1991, pp. 1760-1764.

ABSTRACT: Complications of cardiopulmonary resuscitation (CPR), such as rib fractures and pneumothorax, are not uncommon. The authors report the case of a 69-year-old woman who underwent surgery for a perforated duodenal ulcer. Eighteen hours postoperatively she sustained a cardiac arrest; vigorous resuscitation efforts, using advanced cardiac life-support procedures, failed. At autopsy, she had 350 mL of fresh blood in her pericardial sac, which had caused cardiac tamponade. Three ribs were fractured at the left sternal border. Directly underneath the fractured ribs were a 0.4-cm laceration of the pericardium and an accompanying 0.7-cm laceration of the left ventricle. There was an acute thrombus in the left anterior descending artery. Microscopic examination of the heart showed acute infarction of the left ventricle in the vicinity of the laceration. This case demonstrates that vigorous CPR performed on an acutely infarcted heart can result in lethal cardiac laceration and tamponade.

KEYWORDS: pathology and biology, cardiopulmonary resuscitation, myocardial infarction

Cardiopulmonary resuscitation (CPR) is a well-recognized means of maintaining circulation in persons who have suffered cardiac arrest. In addition to its potentially life-saving benefits, however, CPR, even when performed with proper technique, can be associated with numerous complications. The most commonly observed CPR-related injuries are rib and sternal fractures [1-5]. Other well-known complications include pneumothorax, hemothorax, bone marrow and fat embolization, and rupture or laceration of vital abdominal and thoracic structures, such as the liver, spleen, esophagus, lung, aorta, and heart.

The authors report a case of cardiac tamponade due to myocardial laceration through a site of acute infarction in a woman who had undergone vigorous cardiopulmonary resuscitation.

This report was presented in part at the 1991 Annual Meeting of the American Academy of Forensic Sciences, Anaheim, CA, 18-23 Feb. 1991. Received for publication 11 Feb. 1991; revised manuscript received 30 March 1991; accepted for publication 12 April 1991.

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Case Report

A 69-year-old female with a past medical history of peptic ulcer disease, hypertension, and Type I diabetes mellitus was admitted to the University of Cincinnati Medical Center with complaints of right-sided abdominal pain. Initial physical examination showed a slightly tender epigastrium, without Murphy's or peritoneal signs. Rectal examination was negative for occult blood. Abdominal radiographs revealed a nonspecific bowel gas pattern. There were no air/fluid levels or free air. She was admitted for workup of probable recurrent peptic ulcer disease.

Two days after admission she underwent upper gastrointestinal endoscopy. Following insufflation of her stomach with air, her abdomen became markedly distended and tympanic. A complete perforation of the anterior duodenum was visualized. She was taken immediately to the operating room, where an omental patch was placed over the site of perforation. She was taken to the recovery room in stable condition.

Throughout the evening after surgery she was alert and oriented, and she continued to do well overnight. The next morning, approximately 18 h postoperatively, she experienced a witnessed, sudden cardiac arrest. She was intubated, and advanced cardiac life support procedures were initiated immediately. Resuscitative efforts continued for 45 min, but were unsuccessful. Permission for autopsy was obtained from the family.

Autopsy Findings

At autopsy, the body was that of an obese elderly woman with a recent midline abdominal incision. A catheter was present in the right side of the neck, entering the internal jugular vein. Examination of the abdominal organs revealed a 0.6 by 0.7-cm perforated ulcer in the anterior duodenum, which was covered by an intact omental patch. A fibrinopurulent exudate covered the surfaces of the duodenum and distal stomach.

Examination of the chest wall revealed fractures of Ribs 2, 3, and 4 at the left sternal border. The sternum was fractured transversely between Ribs 2 and 3.

The pericardial sac contained approximately 350 mL of fluid and clotted blood (Fig. 1). A small 0.4-cm laceration with surrounding hemorrhage was noted in the anterior pericardium (Fig. 2). Underlying the site of pericardial injury was a 0.7-cm linear laceration of the left ventricle (Fig. 3). This was surrounded by localized hemorrhage. The jagged edges of the fractured ribs appeared to directly overlie the site of pericardial and left ventricular laceration.

The heart weighed 420 g. Serial cross sections of the coronary arteries disclosed severe atherosclerotic narrowing of all vessels. A recent thrombus completely occluded the lumen of the left anterior descending artery approximately 1 cm distal to its bifurcation. Microscopic examination of the myocardium in the area of laceration showed acute hemorrhage and wavy fiber changes, which are consistent with a myocardial infarction 12 to 24 h old. Thus, the hemopericardium observed in this patient appeared to be the result of penetration of the fractured ribs through the softened area of infarction in the left ventricle during CPR.

The cause of death was attributed to myocardial infarction secondary to coronary atherosclerosis. The manner of death was natural.

Discussion

It is essential that pathologists recognize CPR-related injuries and are able to distinguish them from the sequelae of natural disease processes or trauma incurred prior to cardiac arrest. This is of particular importance in forensic science cases, where interpretation of autopsy findings affects decisions regarding the manner of death of an individual.



FIG. 1—At autopsy, the pericardial sac filled with 350 mL of fluid and clotted blood, causing pericardial tamponade.

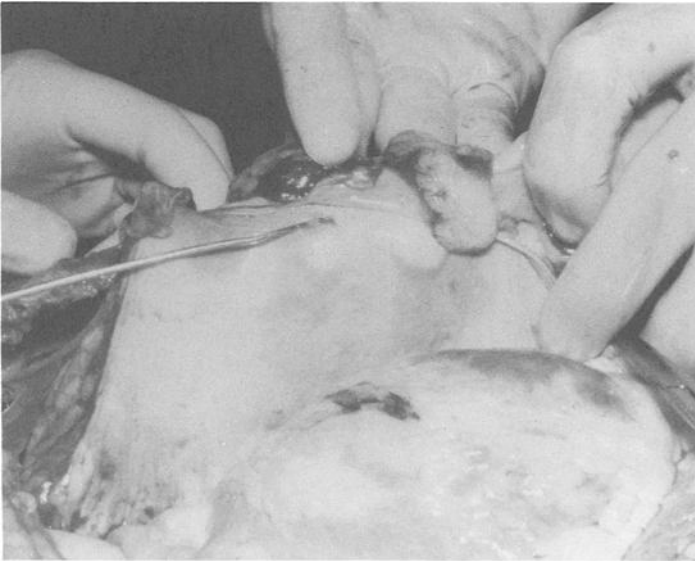


FIG. 2—A small 0.4-cm laceration of the pericardial sac directly underneath the jagged ends of the fractured ribs.



FIG. 3—A 0.7-cm hemorrhagic laceration of the left ventricle present beneath the site of pericardial injury. Microscopic examination of the myocardium in this area revealed acute infarction.

Complications following the administration of CPR are extremely common and often not unexpected. Autopsy studies of hospitalized patients undergoing external cardiac massage have found at least one complication in 21 to 40% of cases examined [1,2]. Many individuals experienced multiple resuscitation-related injuries.

Among the most common of these are fractures of the ribs and sternum. Elderly patients, in whom osteoporosis or other metabolic abnormalities are more frequently found, are especially prone to such injuries. In this patient population, fractures may be unavoidable, even when proper CPR technique is rigidly practiced. Rib fracture may be associated with hemothorax resulting from tearing of intercostal arteries [5,7]. Also common in patients receiving CPR are bone marrow emboli, which are typically observed within the small vessels of the lungs [1,2,4,5,7].

Other CPR-related injuries may occur as a result of poor positioning of the hands during chest compression. Fracture of the xiphoid process by pressure on the distal sternum may result in laceration of the liver and resulting hemoperitoneum [4,6-9]. Perforation of the spleen has also been reported [7,8].

Additional complications include aspiration [2], mediastinal and subcutaneous emphysema [2,7], pulmonary contusion [1], pulmonary laceration [4], aortic rupture [10], and gastric rupture [8,9,11].

Myocardial injury during CPR is relatively uncommon. Right ventricular rupture is an infrequent complication, which presumably occurs when pressure is applied to the chest, obstructing the right ventricular outflow [12]. Laceration of a histologically normal left ventricle may occur as a result of compression of the heart wall against a prosthetic valve [13] or from direct penetration of the myocardium by the ends of fractured ribs [14] or dorsal osteophytes [15].

Laceration of the left ventricle through areas of infarction in patients receiving CPR has been previously reported [2,16]. In these cases, however, it was not possible to distinguish between spontaneous myocardial rupture and potential CPR-related trauma. The case presented in this report suggests that vigorous CPR performed on an acutely

infarcted heart may result in lethal myocardial laceration and cardiac tamponade. It is likely that the softened myocardium in an area of infarction is more vulnerable than healthy heart muscle to CPR-related injury.

Acknowledgments

The authors are grateful to Dr. Robert Pfalzgraf for helpful discussions and to Jay Card for his photographic expertise.

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