CASE REPORT

Cardiopulmonary resuscitation-related renal vein and multivisceral organ injuries: a rare forensic autopsy case

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ABSTRACT

Cardiopulmonary resuscitation (CPR) is a vital life-saving intervention but may result in various traumatic injuries, particularly with vigorous or prolonged efforts. Although visceral injuries are uncommon, they can be fatal. In this report, we present a rare postmortem case demonstrating multiple internal injuries-including pericardial and myocardial lacerations, liver laceration, and renal pelvis and renal vein injury-following CPR. A 70-year-old male was found unresponsive on the roadside and transported to the emergency department, where CPR was initiated due to cardiac arrest. Despite all medical interventions, resuscitation efforts were unsuccessful. Laboratory tests showed elevated cardiac and liver enzymes. A forensic autopsy was performed due to the suspicious nature of the death. External examination revealed no signs of assault; a burn over the sternum was consistent with defibrillator pad contact. CPR-related rib and sternal fractures were observed. A non-transmural myocardial laceration with pericardial injury was noted. Minor intraperitoneal hemorrhage, small hepatic and renal lacerations, and a millimetric tear in the left renal vein were identified. Histopathology revealed severe coronary atherosclerosis with ~80% luminal narrowing. Toxicology detected only therapeutic drug levels. The patient had a history of hypertension without recent cardiac follow-up. Surveillance footage showed the individual clutching his chest before collapsing. In conclusion, this case underscores that multiple internal organ injuries, although uncommon, may arise as complications of CPR. In elderly individuals, reduced tissue resilience may predispose to pericardial, myocardial, hepatic, and renal venous injuries, which should be considered in both clinical management and forensic evaluations.

Keywords: Autopsy; cardiopulmonary resuscitation; resuscitation injuries; renal injury.

INTRODUCTION

Ischemic heart disease is the leading cause of death worldwide, accounting for 13% of all fatalities.[1] Cardiopulmonary resuscitation (CPR) is a critical emergency intervention performed to re-establish oxygen-rich blood circulation to vital organs such as the brain and heart following cardiac arrest.[2] Despite its life-saving potential, CPR can result in a variety of traumatic injuries, particularly in cases involving prolonged or forceful compressions.

Sixty percent of patients sustained CPR-related injury among all CPR cases.[3] The most frequently encountered complications are rib and sternal fractures; however, injuries to internal organs such as the heart, pericardium, liver, spleen, and great vessels have also been reported.[4,5] Although these complications are well documented, visceral organ injuries are relatively rare but may have fatal consequences.[4] While isolated injuries to the myocardium or liver have been sporadically described, the simultaneous occurrence of traumatic damage involving the pericardium, myocardium, liver, and renal vein following CPR is extremely uncommon.[5,6]

Recognition of such rare presentations is critical for both clinical assessment and forensic evaluation. In this report, we present a rare postmortem case featuring multiple internal in-

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juries, including pericardial and myocardial injury, liver laceration, renal pelvis, and renal vein injury, following CPR.

Ethical approval for this study was obtained from the Artvin Çoruh University Scientific Research and Publication Ethics Committee (Decision Number: E-18457941-050.99-175400, dated 28.03.2025). The study was conducted in accordance with the principles of the Declaration of Helsinki.

CASE REPORT

A 70-year-old male was found unresponsive in a prone position on the roadside and was immediately transported by emergency medical services to the district state hospital emergency department. Cardiopulmonary resuscitation was initiated due to cardiac arrest; however, no response was obtained, and the patient was declared dead. Initial biochemical analyses revealed elevated levels of alanine aminotransferase (ALT: 135 U/L, ref: 0-41), aspartate aminotransferase (AST: 114 U/L, ref: 0-40), creatine kinase-myocardial band (CK-MB: 60.3 U/L, ref: 0-25), and troponin I (0.015 ng/mL, ref: 0.003-0.014). As the death was classified as sudden and suspicious, a forensic autopsy was performed.

External examination showed no signs of external trauma or assault. A 4×2 cm area of skin burn was observed over the sternum, suggestive of defibrillator pad contact during CPR (Fig. 1).

During the autopsy, bilateral pneumothorax tests were negative. Multiple rib fractures were identified: on the left side at the parasternal line (2nd-4th ribs), and on the right side at the midclavicular line (2nd rib) and anterior axillary line (5th and 6th ribs). These were determined to be resuscitation-related. The sternum showed a transverse fracture at the level of the 3rd rib and a vertically oriented fracture extending from the same level down to the xiphoid process (Fig. 1). These fractures were associated with a laceration of the anterior pericardium.

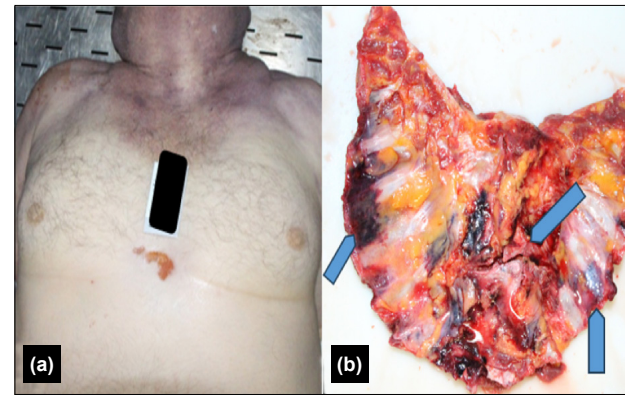

Figure 1. Skin burn and rib and sternum fractures caused by resuscitation. **(a)** Skin burn on the sternum **(b)**Displaced fractures of the sternum and ribs with surrounding ecchymosis.

Examination of the heart revealed a non-transmural myocardial laceration (3.5×1 cm) corresponding to the area of pericardial injury, which did not extend into the cardiac chambers or major vessels (Fig. 2). Upon opening the abdominal cavity, approximately 150–200 cc of intraperitoneal hemorrhage was observed. A 1.5 cm laceration was detected on the anterior surface of the liver (Fig. 3). The left kidney was surrounded by capsular and perirenal hemorrhage, and a 1.5 cm laceration was observed on the posterior surface of the right kidney. Upon further evaluation using a blunt-tipped instrument, all renal vessels appeared macroscopically intact. However, when fluid was injected into the lumen of the left renal vein using a syringe, minor leakage was observed in the mid-portion of the vein, indicating a millimetric injury to the vessel wall (Fig. 4).

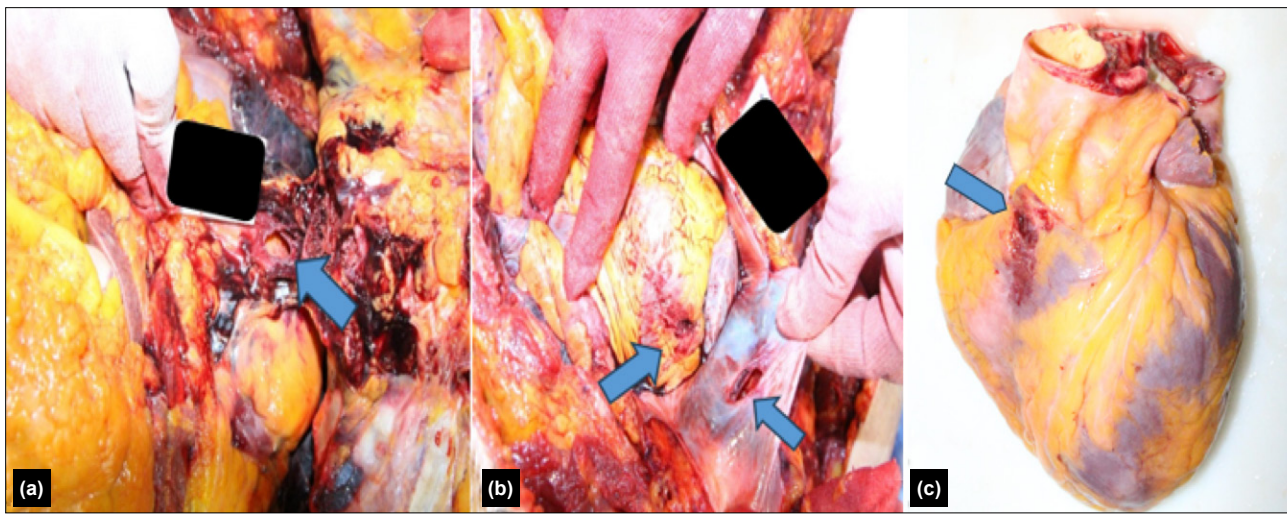

Figure 2. Pericardial and myocardial injuries caused by resuscitation. **(a)** Pericardial laceration **(b)** Combined pericardial and myocardial laceration **(c)** Non-transmural myocardial laceration.

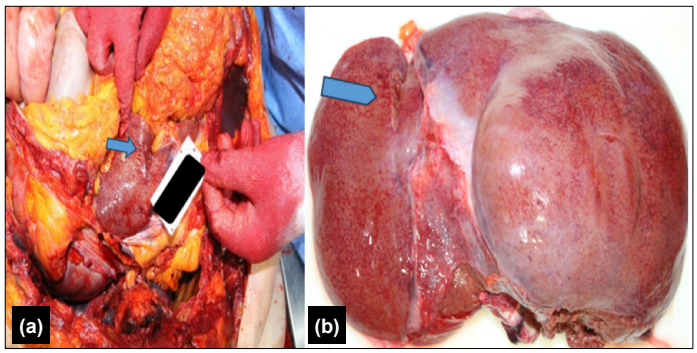

Figure 3. Liver injury caused by resuscitation. **(a)** Liver laceration observed after abdominal dissection **(b)** Anterior surface appearance of the liver laceration on the dissection table.

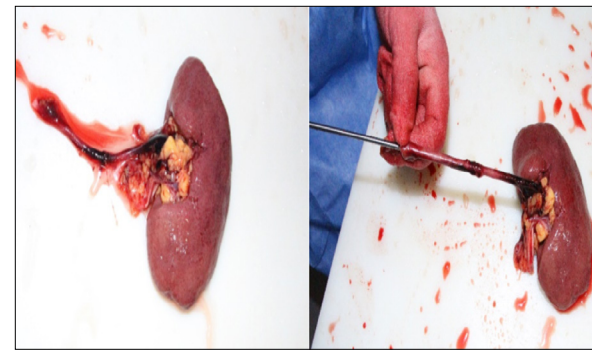

Figure 4. Smearing-type hemorrhage in the left kidney and appearance of the renal vein with blood clots.

Histopathological examination of the coronary arteries revealed advanced atherosclerosis, with approximately 80% luminal narrowing due to calcified atheromatous plaques. Toxicological analysis detected only therapeutic levels of medications.

Review of the patient's medical history through the national health record system revealed a known history of hypertension and long-term antihypertensive use, but no cardiology outpatient visits within the past decade (2015-2025).

Surveillance footage from the scene showed the individual clutching his chest before collapsing. Based on the minimal nature of the renal vein injury and the limited volume of intra-abdominal hemorrhage, this finding was not considered to be the direct cause of death. In light of the elevated cardiac enzymes (CK-MB, troponin I), liver transaminases (AST, ALT), and the presence of severe coronary artery disease on histological analysis, the cause of death was determined to be "atherosclerotic and ischemic heart disease."

DISCUSSION

Cardiopulmonary resuscitation, while a life-saving intervention in cases of sudden cardiac arrest, may lead to serious traumatic complications, particularly when chest compressions are forceful or prolonged. Although rib and sternal fractures are the most frequently reported complications,[4,5] as demonstrated in this case, CPR can also result in injuries to internal organs such as the heart, pericardium, liver, and kidneys.[3,6-8] To the best of our knowledge, this is the first report to document that chest compression provoked renal pelvis and vein injury, let alone caused mortality.

Pericardial and myocardial injuries may occur due to direct mechanical stress exerted on the heart during chest compressions. In elderly individuals, decreased tissue elasticity and the presence of pre-existing cardiovascular disease are significant predisposing factors for such complications.[9] In our case, the presence of both transverse and vertical sternal fractures suggests a mechanism for the pericardial laceration. The non-transmural myocardial laceration observed is likely attributable to repetitive, abrupt chest compressions during CPR.

Although rare, intra-abdominal organ injuries may also occur during CPR. Among these, hepatic and splenic lacerations, gastric dilatation, and gastric perforation are the most commonly reported. Hepatic injury is the most frequently encountered intra-abdominal complication, with an incidence ranging between 0.6% and 3%.[3,7,8] These injuries are typically associated with compressions applied just below the lower sternum. Lacerations observed on the anterior surface of the right hepatic lobe may result from compression of the liver between the diaphragm and thoracic cage during resuscitation efforts.[10] Although several case reports have described CPR-related hepatic lacerations,[4,7,8,10] these injuries are often accompanied by massive internal hemorrhage. In contrast, our case presented with limited intraperitoneal bleeding despite the presence of liver trauma.

Renal and renal vascular injuries are extremely rare following blunt trauma.[11] However, pressure transmitted to the posterior abdominal wall adjacent to the lumbar spine may result in damage to the perirenal tissues. In our case, although the renal vein appeared macroscopically intact, a fine leak detected via fluid injection into the left renal vein suggested a minor laceration of the vessel wall. This finding indicates that abrupt pressure changes within the abdominal cavity during CPR may cause subtle vascular injuries. According to the patient's clinical findings, the most probable cause of the urinary tract injury in this case was chest compression-related trauma, which needs to be taken into consideration.

To date, only one CPR-related renal injury has been reported: a 72-year-old man who sustained bilateral urinary tract damage following CPR. Hematuria and incomplete rupture of the renal pelvis and ureter were the findings of renal damage in that case. He was discharged from the hospital following treatment.[12] However, in our case, a severe renal complication of CPR was noted, which included renal vein perforation and a kidney laceration measuring 1.5 cm in length.

On the other hand, aging is an independent factor that may increase the risk of damage resulting from CPR.[9] Given the age of our case, it could be said that this finding aligns with previously reported data.[12]

Such multi-organ injuries are most often detected during autopsy and hold significant relevance in forensic investigations. Accurate identification of internal organ injuries related to CPR may provide insight into the appropriateness and effectiveness of resuscitative efforts. Furthermore, proper interpretation of these findings is critical for distinguishing CPR-related complications from trauma-induced fatalities in forensic medicine.

Although CPR is an essential life-saving intervention, it can occasionally result in rare but serious internal injuries, including those involving the heart, liver, and kidneys. These complications may not be immediately apparent in clinical settings and are often detected during postmortem examinations. Increased awareness of such injuries is crucial for physicians and emergency healthcare providers, as it may influence the evaluation of CPR outcomes and guide the management of post-resuscitation care. Recognizing the potential for visceral trauma can support more comprehensive assessments, reduce the risk of misinterpretation, and promote safer resuscitation practices.

CONCLUSION

In conclusion, this case underscores that multiple internal organ injuries, although uncommon, may arise as complications of cardiopulmonary resuscitation. Pericardial, myocardial, hepatic, and renal venous injuries-particularly in elderly individuals with decreased tissue resilience-should be taken into account during both clinical assessments and forensic investigations. The intensity and duration of chest compressions appear to be critical factors contributing to such injuries and should be carefully evaluated in post-resuscitative analyses.

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Ethics Committee Approval: This study was approved by the Artvin Çoruh University Scientific Research and Publication Ethics Committee (Date: 28.03.2025, Decision No: E-18457941-050.99-175400).

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OLGU SUNUMU - *ÖZ*

Kardiyopulmoner resüsitasyona bağlı renal ven ve çoklu iç organ yaralanmaları: Nadir bir adli otopsi olgusu

Kardiyopulmoner resüsitasyon (KPR) hayat kurtarıcı bir girişim olmakla birlikte, özellikle uzun süren veya şiddetli uygulamalarda çeşitli travmatik yaralanmalara neden olabilmektedir. Viseral organ yaralanmaları nadir görülse de ölümcül sonuçlar doğurabilmektedir. Bu olgu sunumunda, KPR sonrasında gelişen perikart ve miyokart laserasyonlarının yanı sıra karaciğer laserasyonu ile renal pelvis ve renal ven yaralanmalarını içeren nadir ve çoklu iç organ yaralanmalarını içeren bir postmortem olgu sunulmaktadır. Yolda bilinci kapalı halde bulunan 70 yaşındaki erkek hasta, acil servise getirilmiş ve kardiyak arrest nedeniyle KPR uygulanmıştır. Tüm tıbbi müdahalelere rağmen yaşama döndürülememiştir. Laboratuvar testlerinde kardiyak ve karaciğer enzimlerinde yükselme saptanmıştır. Ölümün şüpheli bulunması üzerine adli otopsi yapılmıştır. Dış muayenede darp-cebir izine rastlanmamış, sternum üzerindeki yanık defibrilatör pedine bağlı olarak değerlendirilmiştir. KPR'ye bağlı sternum ve çok sayıda kosta kırığı, perikardiyal yaralanma ile birlikte miyokardda transmural olmayan laserasyon, hafif intraperitoneal hemoraji, karaciğer ve böbrekte laserasyonlar ile sol renal vende milimetrik yaralanma tespit edilmiştir. Histopatolojik incelemede koroner arterlerde ileri düzey ateroskleroz (yaklaşık %80 lümen daralması) izlenmiştir. Toksikolojik analizde yalnızca tedavi edici düzeyde ilaç saptanmıştır. Hastanın hipertansiyon öyküsü bulunmakta olup, yakın dönemde kardiyolojik takip yapılmadığı öğrenilmiştir. Güvenlik kamerası kayıtlarında kişinin göğsünü tutarak yere yığıldığı görülmüştür. Sonuç olarak, bu olgu KPR sonrası nadir görülen çoklu iç organ yaralanmalarına dikkat çekmektedir. Özellikle yaşlı bireylerde doku dayanıklılığının azalması nedeniyle perikardiyal, miyokardiyal, hepatik ve renal ven yaralanmaların hem klinik hem de adli değerlendirmelerde göz önünde bulundurulması önemlidir.
Anahtar sözcükler: Kardiyopulmoner resüsitasyon; resüsitasyon yaralanmaları; renal yaralanma; otopsi.

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