

## MINI-FOCUS ISSUE: AORTOPATHIES

BEGINNER

## CASE REPORT: CLINICAL CASE

# Aortic Rupture as a Complication of Cardiopulmonary Resuscitation



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## ABSTRACT

A 78-year-old woman with an aortic pseudoaneurysm suffered cardiac arrest due to aspiration and underwent cardiopulmonary resuscitation (CPR), but was found to then be hypotensive with a new chest hematoma. Imaging revealed aortic rupture at the site of the pseudoaneurysm. Aortic rupture is a rare but catastrophic complication of CPR. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2020;2:1150-4) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

A 78-year-old woman with a recently diagnosed and unrepaired aortic arch pseudoaneurysm presented to the emergency department with fever, dyspnea, abdominal pain, and cough for 1 day. On examination, she was found to be febrile with a temperature of 38.5°C, tachypneic to 22/min and markedly frail with a body mass index of 18.9 kg/m<sup>2</sup>. Blood pressure on admission was 117/68 mm Hg. She was lethargic but responsive, and had mild suprapubic tenderness to palpation. Workup was notable for peripheral leukocytosis to

16.5 × 10<sup>9</sup>/μl, pyuria with >50 leukocytes per high-power field, and gram-negative bacilli in urine and blood cultures.

She was started on intravenous piperacillin-tazobactam and given isotonic intravenous fluid. Approximately 24 h into admission, she had a witnessed aspiration event while eating and promptly went into hypoxic respiratory failure with ensuing pulseless electrical activity. A total of 8 min of high-quality manual cardiopulmonary resuscitation (CPR) was immediately performed and an endotracheal tube inserted, with subsequent return of spontaneous circulation (ROSC). Standard compression depth of 2.0 to 2.5 inches was used, with optimal CPR quality demonstrated by end-tidal capnography. Immediately after ROSC, the patient was found to be hypotensive to 70/30 mm Hg, and a new large area of ecchymosis in the upper chest and neck with associated crepitus was observed.

## LEARNING OBJECTIVES

- To recognize the spectrum of traumatic complications resulting from cardiopulmonary resuscitation.
- To recognize aortic rupture as a rare complication of cardiopulmonary resuscitation and consider rapid evaluation for this catastrophic, yet potentially treatable condition in a patient with return of spontaneous circulation after successful cardiopulmonary resuscitation.

## PAST MEDICAL HISTORY

The patient had a complex medical history comprising coronary artery disease with a remote

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history of percutaneous coronary intervention, vascular dementia, stage III chronic kidney disease, hypertension, and severe gastroesophageal reflux disease (GERD). Notably, she was admitted to our hospital 1 week before the current admission, with worsening dyspepsia typical of her prior exacerbations of GERD. Acute coronary syndrome was ruled out and esophagogastroduodenoscopy showed friable mucosa with severe esophagitis. She was incidentally found to have a prominent aortic knob with borderline wide mediastinum on her chest x-ray, that prompted a computed tomography (CT) aortogram. This showed a diffusely calcified aorta and a pseudoaneurysm of the aortic arch immediately distal to the takeoff of the left subclavian artery, deemed likely to have originated from a penetrating atherosclerotic ulcer (Figure 1). Because of lack of symptoms and the presence of frailty and multiple comorbid medical conditions, the patient was deemed to be at high risk for surgical aortic repair and was discharged with a plan for close outpatient follow-up with cardiothoracic surgery within 2 weeks.

## DIFFERENTIAL DIAGNOSIS

Our immediate concern was esophageal rupture due to inadvertent traumatic intubation of the esophagus. We were also concerned about a hemopneumothorax due to skeletal trauma from CPR, which had a high likelihood of occurring given the patient's frailty. Lower down on the differential diagnosis was a myocardial or major vascular complication of CPR, including dissection or rupture of the aorta, myocardial contusion, hemo-pericardium with tamponade, and myocardial rupture.

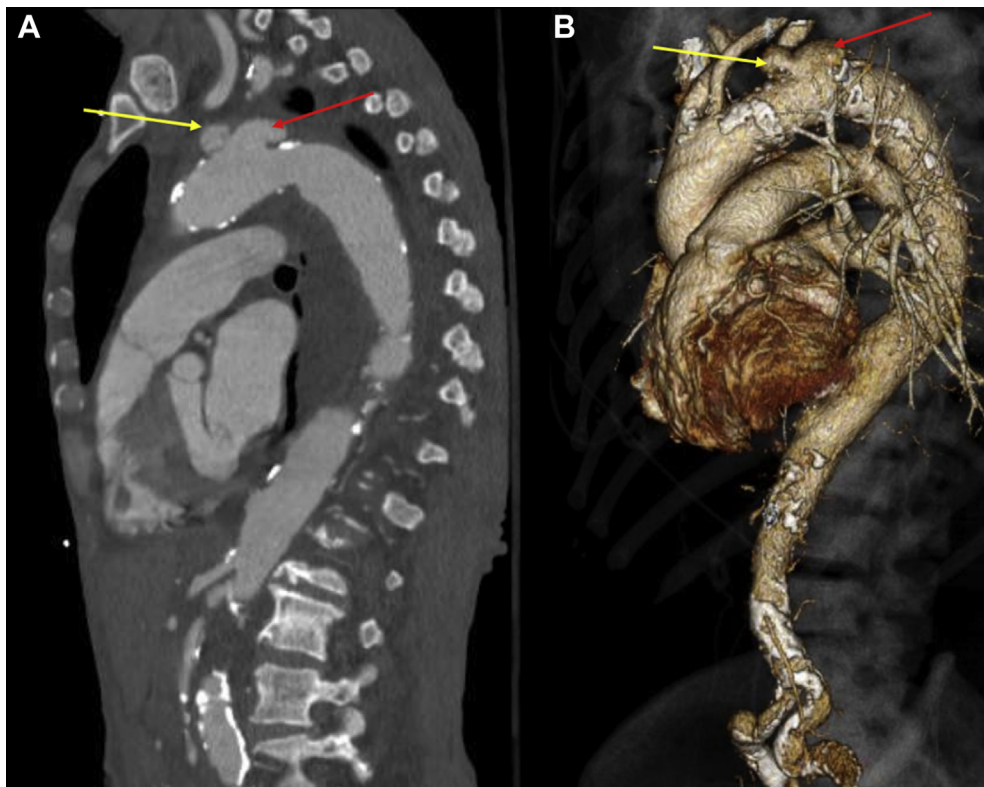
## INVESTIGATIONS

Position of the endotracheal tube was confirmed by auscultation to be in the esophagus. The tube was removed and the patient was re-intubated correctly. Emergent chest x-ray demonstrated proper endotracheal intubation and no hemothorax or

## ABBREVIATIONS AND ACRONYMS

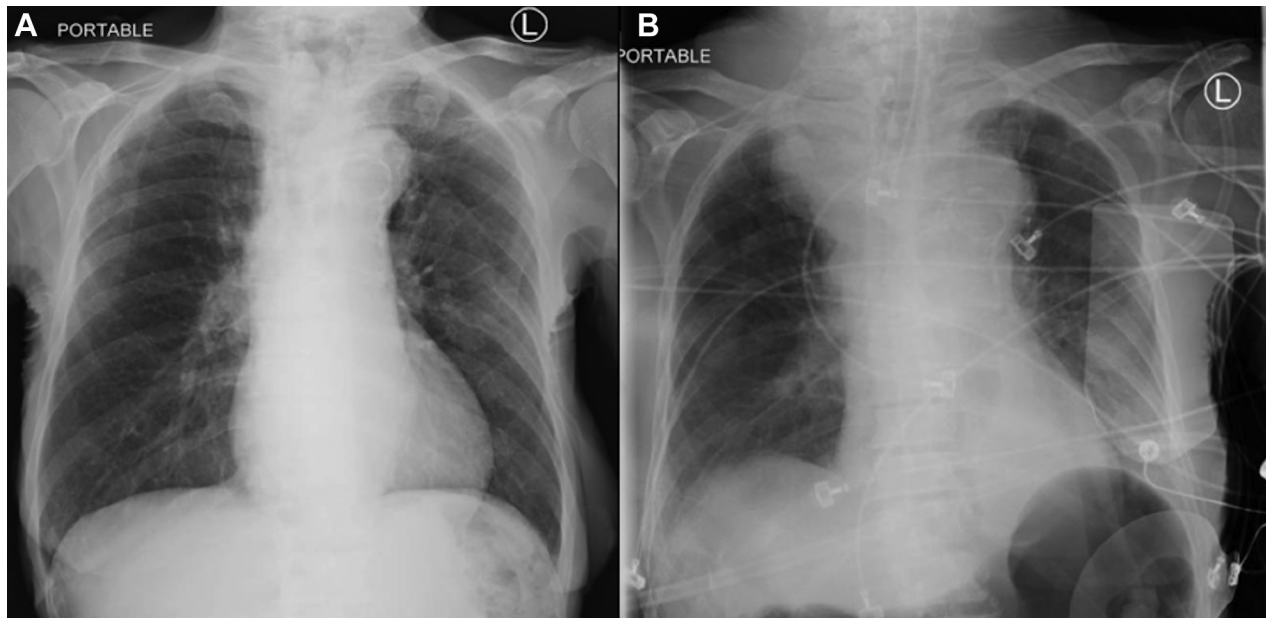
- CPR** = cardiopulmonary resuscitation
- CT** = computed tomography
- GERD** = gastroesophageal reflux disease
- ROSC** = return of spontaneous circulation
- TEE** = transesophageal echocardiography

**FIGURE 1** Baseline Computed Tomography Aortogram



**(A)** Sagittal view of computed tomography angiogram and **(B)** corresponding 3-dimensional volume-rendering reconstruction of the thoracic aorta showing a pseudoaneurysm (red arrow) at the aortic arch immediately distal to the takeoff of the left subclavian artery (yellow arrow).

**FIGURE 2** Comparison of Admission and Post-Cardiopulmonary Resuscitation Chest X-Rays



**(A)** Anteroposterior chest x-ray obtained on current admission showing prominent aortic knob. **(B)** Anteroposterior chest x-ray obtained after cardiac arrest and return of spontaneous circulation showing marked new mediastinal widening with encroachment on the right upper lung field.

pneumothorax, but a markedly widened mediastinum. This finding was new compared with a portable anteroposterior chest x-ray done earlier in the day (Figure 2). Emergent CT aortogram was hence done, showing rupture of the aortic arch pseudoaneurysm and a large mediastinal hematoma (Figure 3). Of note, there was no evidence of sternal or rib fracture on either imaging modality.

### MANAGEMENT

The patient was emergently transfused with 3 U of red blood cells and cardiothoracic surgical consultation was obtained. The option of high-risk aortic surgery in light of sepsis due to gram-negative bacteremia (subsequently found to be *Escherichia coli*), shock, and comorbid conditions was discussed with the patient's health care proxy and family. A joint decision was taken to not operate and instead provide palliative care.

### DISCUSSION

CPR, when performed correctly, can be a lifesaving procedure. The repeated forceful compression and decompression of the thorax, however, can lead to

traumatic complications, which are well documented. Most commonly, these involve skeletal chest injuries, with a large autopsy series evaluating CPR-related injuries documenting rib fractures in 73% and sternal fractures in 56% of cases respectively (1). Visceral injury, particularly cardiovascular trauma from CPR, is much rarer yet dire.

The spectrum of cardiovascular trauma from CPR includes direct injury to the heart muscle, valves, pericardium, and great vessels (2). Hemopericardium with or without cardiac tamponade has been reported in 7.5% of patients post-CPR, and myocardial contusions have been seen in up to 2% (2). Catastrophic myocardial rupture has been described, in the context of severe rib and/or sternal fractures with bony fragments suspected to have lacerated the myocardium (3,4).

Evidence of CPR-related aortic injury is extremely rare and limited to a few case reports that describe aortic dissection (5,6) and rupture. Nelson and Ashley (7) reported the first case of aortic rupture due to external cardiac massage in 1965; the injury was thought to have occurred due to penetration by a fractured sternum. Bodily and

Fischer (8) and Patterson et al. (9) reported a total of 4 cases of CPR-associated aortic rupture, 3 of which involved mechanical compression devices and severe concomitant rib and sternal fractures. Indeed, mechanical compression devices used to administer CPR have been implicated in catastrophic penetrating trauma to both the heart and aorta (3,8); the aforementioned prospective autopsy study by Smekal et al. (1) found a 2-fold risk of CPR-related injuries conferred by the use of a mechanical CPR device. All cases of injury to the great vessels occurred in patients with mechanical CPR (1).

It must be underscored that because of their lethal nature, the vast majority of cases of CPR-associated aortic injury and all cases of aortic rupture have been discovered on autopsy. The case we have described is unique in that the diagnosis of aortic rupture was made clinically in a live patient after ROSC. This points to the critical need to consider and rapidly evaluate for aortic injury in the face of hemodynamic instability immediately after CPR, because in a different patient our discovery may have led to an emergent and lifesaving surgical intervention.

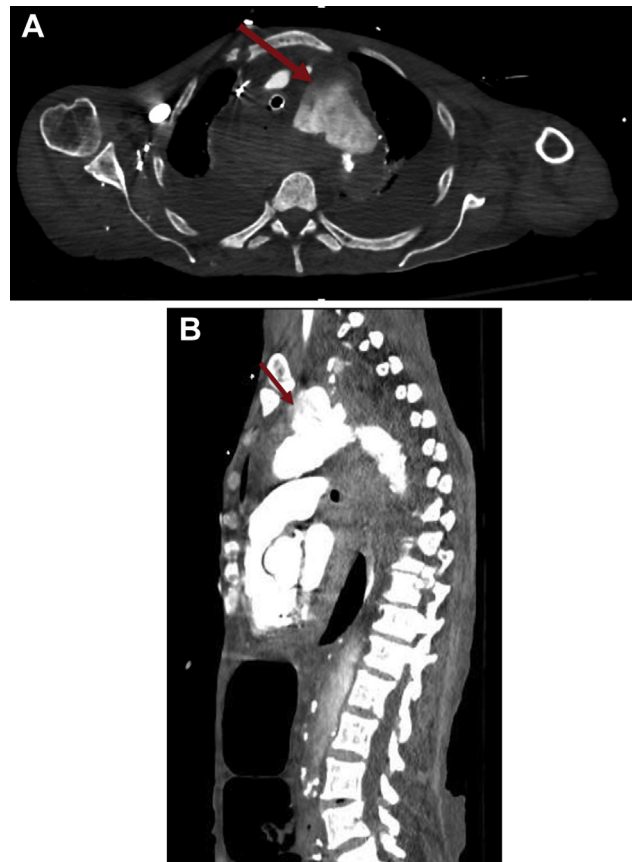
Aortic rupture can be diagnosed by aortography or transesophageal echocardiography (TEE). CT aortography was chosen due to the immediate availability of the CT scanner, the patient's history of severe esophagitis, and esophageal insufflation due to inadvertent intubation potentially reducing image quality and hence diagnostic accuracy of TEE.

Our case is also unique in that aortic rupture occurred in the absence of any concomitant rib or sternal fractures. The likely mechanism in our patient was an explosive increase in aortic wall stress during CPR overwhelming an already weakened vascular wall at the site of pseudoaneurysm. Bodily and Fischer (8) report the only other case in which a preexisting aortic abnormality, atherosclerotic plaque at the aortic root, may have served as a nidus for rupture, although that patient also suffered sternal and multiple rib fractures.

#### FOLLOW-UP

The patient was managed with comfort measures and was terminally extubated 48 h into admission. Autopsy was declined by the health care proxy and hence not performed.

**FIGURE 3** Computed Tomography Aortogram After Cardiopulmonary Resuscitation



(A) Axial and (B) sagittal views of computed tomography aortogram performed emergently after cardiopulmonary resuscitation, showing rupture of the anterior aspect of the previously seen pseudoaneurysm (red arrow) with surrounding mediastinal hematoma.

#### CONCLUSIONS

Our case highlights aortic rupture as a rare, catastrophic complication of CPR in the absence of skeletal trauma, diagnosed clinically in the immediate post-resuscitation period. A high index of suspicion for this entity should be maintained, particularly in a patient with preexisting aortic disease, given the potential for lifesaving surgical intervention.

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**KEY WORDS** cardiac arrest, complications, pseudoaneurysm