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(CASE REPORT)

A case of therapeutic cardiopulmonary resuscitation for pericardial tamponade

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Abstract

A unique case of therapeutic cardiopulmonary resuscitation (CPR) after cardiac tamponade secondary to postoperative complication resulted in hemodynamic improvement. Our patient initially had pericardial effusion with concerns for a hematoma secondary to cardiac catheterization with stent placement. Multiple attempts at pericardial drainage were done, however the patient became unstable during the procedure. CPR was used therapeutically during cardiac arrest to help remove fluid around the heart. CPR is known to cause cardiac tamponade and also rarely treats cardiac tamponade in certain cases. There is little detail on cases with CPR therapeutically removing fluid accumulating in the pericardium. With CPR, increased pressure on the pericardium can lead to reduction of pericardial fluid. The true mechanism of this is unknown but may be related to rupture of the pericardium with fluid draining into the pleural space. This case will document a patient who recovered from postoperative cardiac tamponade after therapeutic CPR was performed.

Keywords: Cardiac Tamponade; Cardio Pulmonary Resuscitation; Pericardial Effusion; Pericardial Window; Cardiac Catherization

1. Introduction

Cardiac tamponade results from pericardial fluid building in the pericardial layer leading to obstruction of heart ventricles. This is a life-threatening scenario which requires immediate intervention. Even if effectively treated, cardiac tamponade not caused by malignancy has a 15% 12-month mortality. (1) Pericardial effusion after percutaneous coronary intervention (PCI) is not an unusual finding. One study found that 16.3% of PCI produced some sort of pericardial effusion, however patients are generally asymptomatic. (2) These effusions are often from postoperative inflammatory reactions. Coronary perforation is a common cause of cardiac tamponade after PCI and is generally a rare complication around 0.2-0.6%. (3)

Cardiac tamponade can present with chest pain, shortness of breath, and palpitation. In severe cases, altered mental status can be seen like in this case. Beck's triad of hypotension, jugular venous distention and muffled heart sounds are common findings in cardiac tamponade, along with those physical exam findings of kussmaul sign and pulsus paradoxus. Most common electrocardiogram findings of cardiac tamponade are sinus tachycardiac but electrical alternans can be seen. X-ray and computed tomography can show cardiac tamponade findings but echocardiography is the most useful imaging bedside available for these unstable patients. (1) When treating tamponade, typically echocardiography is used during pericardiocentesis. A needle can be placed to help extract the pericardial fluid and in some situations a drain can be placed to help continuously drain the fluid. (1) Typically, due to lower pressures, the right ventricle is affected first before the left side. (4) In more complicated cases of cardiac tamponade, surgical intervention can be used. Pericardial windows or removal of the pericardial sac are possible options. (1) Pericardial windows allow for fluid to drain into the pleural space to prevent fluid from coming back. (4) This is through making a hole in the pericardium.

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What makes this case unique, was that initially pericardiocentesis was attempted with no improvement. Only after CPR was performed during cardiac arrest, significant improvement in the reduction in the pericardial fluid was seen. During CPR, intrathoracic pressure is increased leading to compression of the heart. (5) This propels blood through the circulatory system to help perfusion. This increased thoracic pressure can help reduce the pericardial fluid around the heart. Upon review, there were not many documented cases of this scenario. The goal of this case is to show a unique case where cardiopulmonary resuscitation was used after unsuccessful pericardiocentesis attempts.

2. Case Presentation

The patient is an 87-year-old female with a past medical history of heart failure reduced ejection fraction, hyperlipidemia, hypertension and type 2 diabetes who initially presented for dyspnea on going for 4 days prior. This dyspnea had progressively gotten worse, leading to her coming to the emergency department. On admission, the patient did endorse chest pain along with troponin elevation of 87, which eventually peaked at 175. Initial Electrocardiogram showed sinus rhythm and left axis deviation and left bundle branch block. Patient was also noted to have elevated blood pressures up 150/71. Patient was placed on 3L of oxygen. Nitroglycerin, furosemide and 325 mg aspirin were administered by the emergency department. Initial computed tomography with angiography (CT) of the chest was performed to rule out pulmonary embolism. This imaging showed small pericardial effusion of 1.7 cm along the right atrium and small sized pleural effusions. Initial echocardiogram noted small pericardial effusion and ejection fraction of 30-35% prior to catheterization. Cardiology was consulted at this time and cardiac catheterization was planned. High-grade stenosis of mid left anterior descending artery was found on catheterization and drug eluting stent was placed which reduced stenosis from 80% to 0%.

Post catheterization, the patient was noted to have increased dyspnea. Patient was saturating 99% and blood pressure was 119/69 post procedure but it then had dropped to 70/30. A rapid response was called in the recovery room. Patient was placed on BIPAP. Arterial blood gas did not show any specific findings. Initial electrocardiogram was ordered showing normal sinus rhythm and first-degree heart block. Stat echocardiogram was ordered. A large pericardial effusion was noted on anterior/anteroseptal border 1.13cm, right ventricular pericardial effusion of 2.6cm, apical pericardial effusion of 1.4 cm, collapse of right atrial, collapse of right ventricle, and severe decrease in left ventricular function down to 10-15% ejection fraction were all noted on echo. Echo also noted “swinging” of the left ventricle which is a finding concerning a possible postoperative hematoma. The intensive care unit (ICU) team was alerted and a central line was placed. Vasopressor drips were started including norepinephrine. Pericardiocentesis was performed by the cardiovascular thoracic surgery team. Two attempts at pericardiocentesis were made. On the second attempt, the patient became bradycardic and hypotensive leading to a cardiac arrest. Bloody fluid was withdrawn on both attempts during pericardiocentesis but there was no change in hemodynamic status. CPR was performed for 11 minutes. Return of rhythm and pulse were achieved. Post code echo noted significant improvement right ventricular function was noted to be normal, no right atrial, right ventricular collapse and left ventricular function was noted to have a 40% ejection fraction. During code, the patient was intubated by the ICU team and admitted to the ICU.

While in the ICU, the patient was placed on dopamine and norepinephrine drips along with mechanical ventilation and sedation. Patient was monitored with serial echocardiograms, in case effusion returned with a plan for pericardial window if significantly enlarged. Repeat echo showed improvement in ejection fraction of 45% and trivial pericardial effusion. Pericardial window was never required for this patient. Patient was held on heparin due to concerns of a hematoma but dual antiplatelet therapy was continued after placement of a drug eluting stent. Patient was weaned off norepinephrine and then dopamine. Patient was extubated after a successful breathing trial without ever requiring repeat intubation. Post cardiac arrest, the patient had issues continually with bilateral pleural effusions, their origins were unclear. Right sided thoracentesis was performed due to accumulation of fluid and 1050cc of serosanguineous fluid was removed. Pleural studies noted exudative effusion but no other pathology or pleural studies were performed. Within two days for thoracentesis, the patient was noted to have a significant drop in hemoglobin of 6.5 requiring transfusion. CT chest was ordered after concerns of a pleural bleeding, imaging showed significant bilateral pleural effusions and re-accumulation. For a second time, the patient had a significant drop of hemoglobin down to 4.7 requiring multiple units to be transfused. Cardiothoracic surgery continued to follow and had concerns of bleeding into the pleural space leading to IR placing bilateral pigtail pleural catheter to drain bloody pleural effusion. Hemoglobin did eventually stabilize with not acute drops in hemoglobin requiring transfusion the rest of the admission. Chest tubes were placed to suction and eventually to water seal after output had significantly decreased. Left chest tube was removed first, with the right side still producing large output after the left side was removed. Nine days after the left sided chest tube was removed, the right sided chest tube was removed. Patient was able to tolerate well after removal and was discharged home on 2L of oxygen after clearance from the primary team and physical therapist.

3. Discussion

This case shows effective use of CPR for the removal of pericardial tamponade. There are not many documented cases of this situation and it is not well studied. While the mechanism behind acute change is unclear, one documented case showed a possible cause. In that case, post myocardial infarction induced cardiac tamponade showed CPR effectively removing the pericardial fluid. (6) A known possible complication of CPR is pericardial rupture. In this case, CPR caused an iatrogenic rupture of the pericardium which released pressure induced by the fluid into the pleural space. (6) This is the same concept of a surgical pericardial window creating a hole in pericardium to reduce pressure. CPR can create a shearing force at pleural and diaphragmatic pericardium, this is the likely mechanism inducing pericardial tear or unintentional window due to compressions. (7) While no tear was clearly noted on the echocardiogram, the patient did have extensive hemorrhagic pleural effusions which would be reasonable for an iatrogenic pericardial tear draining into the pleural space. Another previous case, denoted a similar finding to our case in which CPR reduced a cardiac tamponade. While they did not have a clear documented pericardial tear on echocardiogram, like our case the patient did have a large pleural effusion not noted on admission. (8)

While this patient was able to leave hospital with minimal long-term consequences, oftentimes pericardial rupture is fatal for patients. One article discussed two cases where pericardial ruptures led to death. Both these patients were studied on autopsy and noted to have hemothorax. (9) This patient was lucky to not have many of the common complications of CPR like rib and sternal fractures. (7) Hemothorax/pleural effusions occurs in 2.1% of documented cases according to one study of pooled complications of CPR. (10) Also, pericardial injuries of all causes occur in 8.9% of these cases in the study. (10) This patient experienced extremely fortunate circumstances, which allowed for a positive patient outcome. This patient never required surgical intervention on this admission which is important because pericardial window procedures are not without risks. While only for patients with malignant pericardial effusions, one study found an 8.33% 30-day mortality rate. (11)

4. Conclusion

Cardiac tamponade is a life-threatening diagnosis which requires immediate intervention. Rarely, it can be a complication of percutaneous coronary intervention. While pericardiocentesis is typically the initial treatment, CPR has been known to reduce pericardial effusions in rare situations. This case showed the importance of timely and effective use of CPR and how its use can impact outside of just perfusion.

Compliance with ethical standards

Disclosure of conflict of interest

The above listed authors have no conflicts of interest to declare.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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