Trauma and Emergency Care

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Cardiac arrest post bone marrow biopsy: Role of Extracorporeal Cardiopulmonary resuscitation (ECPR) during cardiac arrest in Emergency Department

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Abstract

A young patient suffered a cardiac arrest post iatrogenic vascular injury during a scheduled bone marrow biopsy for investigation of pancytopenia. The patient had two more cardiac arrests in Emergency department (ED) whilst massive transfusion was being carried out. Extracorporeal cardiopulmonary resuscitation (ECPR) was started due to hypoxemic respiratory failure, before transfer to operative room for a successful repair of the injured vessel. Patient was gradually weaned off all extracorporeal cardiorespiratory support and discharged home one month later, with no neurological deficit. Timely decision to start ECPR in selective cardiac arrest patients contributed to a successful outcome.

Case scenario

A 28 years old presents in the ED after being resuscitated for a cardiac arrest in an outpatient clinic, where she had a scheduled bone marrow biopsy for investigation of pancytopenia. She had known history of G6PD since childhood and no other diagnosed illness. During the procedure, the patient collapsed and suffered a cardiac arrest. Hospital "rapid response team" (RRT) resuscitated the patient on scene and brought her to the ED for further stabilisation and urgent CT imaging. The patient had two further episodes of cardiac arrest in the ED. Following the second arrest, ECPR was incorporated in the treatment plan. CT abdomen showed massive bleeding from the injured left internal iliac artery. The patient was transported to the operating room, where she had a successful repair of the injured artery. The patient was transferred to intensive care unit (ICU), post-surgery where she gradually weaned off extracorporeal support followed by a successful discharge one month later. There were no neurological deficits at the time of discharge.

Introduction

ECPR is carefully deployed during selective cases of refractory cardiac arrest [1]. Cardiac arrest is an important public health concern affecting approximately 210,000 people in US each year within the hospital & 400,000 people out of hospital [2,3]. The causes of cardiac arrest include acute coronary syndrome, pulmonary embolism, hypovolemia among many other conditions [4]. Mechanical circulatory support which has been increasingly utilized during the cardiac arrest resuscitation phase is veno-arterial extracorporeal membrane oxygenation (ECMO). It is similar to a heart lung by pass machine used in open heart surgery. It pumps and oxygenates blood outside the body allowing the heart and lung to rest [5]. The sooner the organs and the tissues get oxygenated, the better the chances of survival of the organs and tissues, which leads to better outcomes.

Patients that are placed on ECMO for refractory cardiac arrest typically have a drainage cannula in the femoral vein and a return cannula in the femoral artery. ECPR plays a significant role, when carefully considered in selective cases of refractory cardiac arrest [6].

The clinical course

Patient attended for a planned bone marrow biopsy procedure for pancytopenia investigation. Immediately post biopsy (from the left iliac crest), she collapsed and was found in cardiac arrest. RRT resuscitated her on the scene and managed to get return of spontaneous circulation (ROSC). A working diagnosis of iatrogenic vascular injury (which is a reported complication of bone marrow biopsy) was made and she was destined for interventional radiology (IR) to have embolisation. Before heading to IR, patient was transferred to ED for transfusion of blood products due to a significant drop in hemoglobin.

Patient started to have progressive abdominal distension during the transfusion process. CT abdomen was immediately carried out, which showed significant extravasation of contrast from the left iliac artery and a blood-filled abdominal cavity.

Patient later started to have frothy secretions from the endotracheal tube associated with progressive difficulty in ventilation. There was severe hypoxemia despite full blown ventilatory support. Patient also had two brief episodes of cardiac arrest followed by ROSC whilst being resuscitated in ED.

ECPR team was contacted at that point to assess the patient for ECMO.

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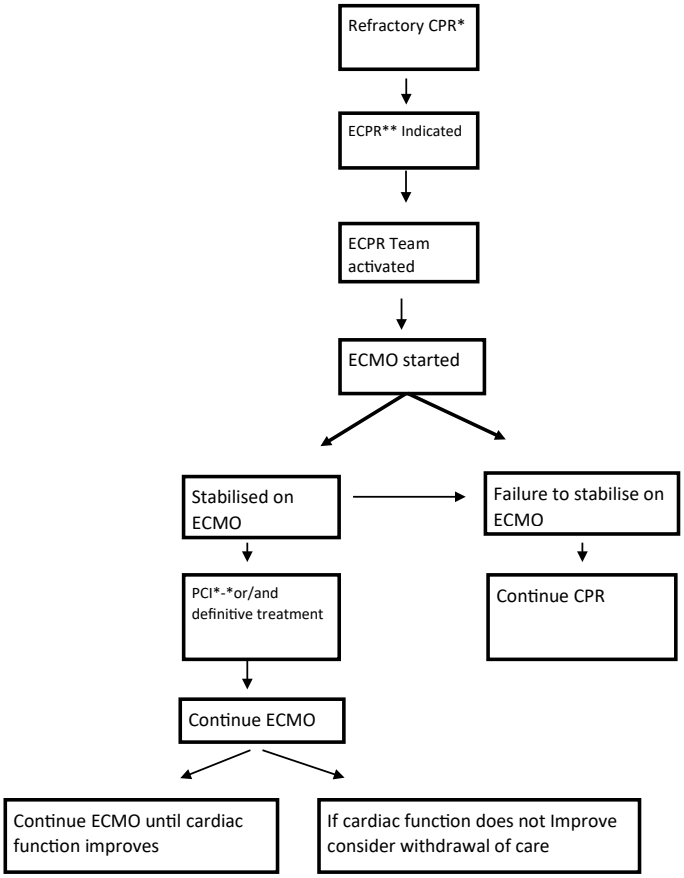


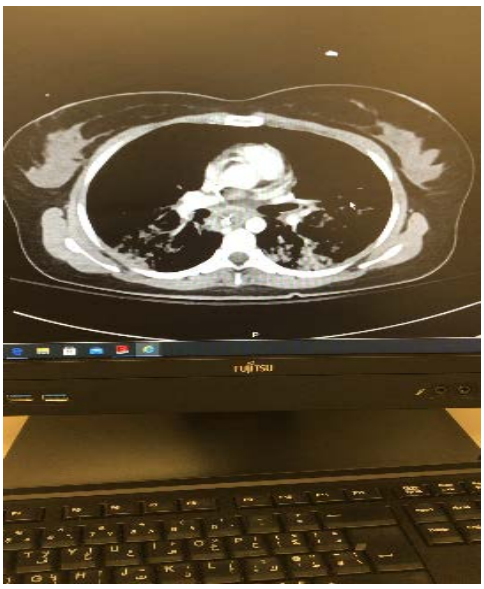
Flow Chart. Flow chart to start ECPR

*cardiopulmonary resuscitation

**Extracorporeal cardiopulmonary resuscitation

***Extracorporeal membrane oxygenation

- Percutaneous coronary intervention



At the time of assessment, patient was severely hypotensive (58/24 mmHg) and desaturating to 72% despite maximum circulatory & ventilatory support.

ECPR team discussion

The previously designated team comprising of two ICU consultants quickly discussed the undermentioned "Risks and benefits" and decision to start the patient on ECMO was agreed.

Risks: Patient had thrombocytopenia and acquired disseminated intravascular coagulation (DIC) due of consumption coagulopathy triggered by massive transfusion hence the risk of bleeding post ECMO cannula insertion was high. Abdominal compartmental syndrome (due to leakage of blood from the injured artery) had the potential to impair venous flow. Patient's neurological status was uncertain due to three cardiac arrest episodes.

Benefits: Patients' hypoxic respiratory failure, attributable to pulmonary edema and transfusion related acute lung Injury (TRALI) was potentially reversible with ECMO use. Patients' young age with no previous co-morbidities was a strong positive. The iatrogenic vascular injury which led to cardiac arrest was completely repairable.

Operative course: Patient had a successful repair of her internal iliac artery and evacuation of two liters of abdominal hematoma. The abdominal wound was left open for a second look laparotomy carried out the following day. The second surgical review showed no further hemorrhage or hematoma hence the abdomen was temporarily closed. Third surgical review carried out on the 4th day showed complete homeostasis followed by complete abdomen closure.

Further clinical course: Patient was kept on ECMO in ICU, post vascular repair with inotropic support. On the 5th day, patient was noted to have some limb movements which led to electroencephalography (EEG). It was suggestive of diffuse non specific cerebral dysfunction with no epileptiform discharges.

Patient was gradually weaned off inotropes by the 6th day. Extracorporeal support was lowered on the 7th day due to improving tidal volumes. ECMO was weaned off over the next couple of days with successful decanulation on the 10th day. The subsequent clinical course showed consistent recovery with a hospital discharge after a month.

Discussion

ECPR should be considered an integral part of cardiac arrest situations.

It can be a life saving adjunct, if deployed in a timely manner on a carefully considered cohort of patients. Each refractory cardiac arrest situation should be thoroughly assessed for ECMO [7].

Cardiac arrests generally carry a poor prognosis but "in hospital cardiac arrests" with a clear reversible cause can have a satisfactory outcome. ECPR should be seriously considered for those situations. In our patient, hemorrhagic shock led to the cardiac arrest and ECMO perfectly supported the organs whilst the definitive cause was being corrected [8].

Availability of an ECPR team is dependent on appropriately competent people with other supportive resources, Clear pathways and guidelines would help keep this resource available and utilised in an appropriate manner [9,10].

Unnecessary delay in getting definitive treatment can seriously effect patients' prognosis [11,12]. In retrospect, our patient had a delay in getting vascular repair due to unnecessary diversion towards ED, for transfusion reasons. A better plan could have been a direct transfer to the operation room from the scene of first cardiac arrest, with stabilisation on route [13,14].

The unnecessary time spent in ED led to two further cardiac arrests. Nevertheless, the support offered in ED through ECMO before and after the operative homeostasis helped the organs recover smoothly. Careful planning & prioritisation around a cardiac arrest situation can help improve outcomes [15].

A completely intact neurological system despite three cardiac arrests was an unexpected outcome in our patient. The rigorous cardiopulmonary resuscitation, timely incorporation of ECMO and satisfactory treatment of the cardiac arrest cause helped the organs stay adequately perfused.

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