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Review Article

Post-resuscitation care for survivors of cardiac arrest



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ABSTRACT

Cardiac arrest can occur following a myriad of clinical conditions. With advancement of medical science and improvements in Emergency Medical Services systems, the rate of return of spontaneous circulation for patients who suffer an out-of-hospital cardiac arrest (OHCA) continues to increase. Managing these patients is challenging and requires a structured approach including stabilization of cardiopulmonary status, early consideration of neuroprotective strategies, identifying and managing the etiology of arrest and initiating treatment to prevent recurrence. This requires a closely coordinated multidisciplinary team effort. In this article, we will review the initial management of survivors of OHCA, highlighting advances and ongoing controversies.

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1. Introduction

Cardiac arrest (CA) is often the terminal event following progression of and decompensation from a wide range of pathophysiological events. With medical advances and improvements in the delivery of prehospital care, we are witnessing increasing rates of return of spontaneous circulation (ROSC) following CA. Once resuscitated, the next challenge is to manage these patients appropriately so as to not only prevent mortality but preserve neurological and

cognitive function. Proper post-resuscitation care (PRC) has been shown to reduce mortality and morbidity.^{1–3} To achieve this, a closely coordinated multidisciplinary team effort is required. The key steps involved in caring for these patients include:

- Assessment and stabilization of cardiopulmonary status
- Determining etiology of arrest
- Neuroprotection
- Preventing recurrence of arrest.

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All these steps generally must start simultaneously once the patient regains a pulse. A schematic overview of managing patients post-ROSC is outlined in Fig. 1.

2. Prehospital management

After ROSC, (defined as a palpable pulse and recordable blood pressure and if monitored, increase in ETCO_2 of >40 mm of Hg), emergency medical services (EMS) personnel should transport patients to facilities equipped with managing the complex needs of these patients. It may be safe to bypass closer medical facilities and transport patients to institutions capable of meeting the needs for PRC.^{4–6} Prior to and during transport, intravenous access should be established and circulation, airway and breathing (CAB) supported in accordance with basic and advanced cardiac life support guidelines. If possible, a 12-lead electrocardiogram (ECG) should be obtained. If the field ECG is consistent with a ST-segment elevation myocardial infarction (STEMI), the cardiac catheterization team at the receiving facility should be alerted. Although some EMS systems currently initiate therapeutic hypothermia (TH) for neuroprotection in patients who remain comatose post-ROSC, there is lack of conclusive evidence of improvements in outcomes when compared to delayed initiation of hypothermia in the ED.⁷ Until, further evidence becomes available, the strategy of prehospital post-resuscitation hypothermia cannot be routinely recommended.

3. Emergency Department (ED) management

Initial management of patients post-ROSC involves a multi-system approach⁸ and should focus on several key areas simultaneously:

- Adequate ventilation and oxygenation
- Hemodynamic optimization
- Cardiovascular stabilization
- Management of metabolic derangements
- Determining the etiology and initiating treatment of the etiology of arrest
- Neurological assessment and consideration of therapeutic hypothermia.

Upon arrival in ED, patient's cardiopulmonary and neurological status should be promptly assessed. Continuous cardiac monitoring, pulse oximetry, capnography and NIBP (non-invasive blood pressure) monitoring should be initiated. This provides critical information on tissue oxygenation and perfusion and helps guide further resuscitative care.

A **brief and focused history** should be obtained if feasible. Since most patients may be unable to communicate, this may need to be obtained from EMS personnel, family, friends or bystanders who have witnessed the arrest. Up to 80% of patients have symptoms preceding the arrest.⁹ Historical evidence of chest pain, shortness of breath, palpitations, light headedness, abdominal pain, back pain, recent infection, loss of postural tone, focal neurological deficits, seizures, and evidence of trauma or bleeding may provide clues to specific

etiologies. Information should also be obtained about past medical history, recent travel, medications, known allergies and whether patients were eating at the time of arrest.

A **focused physical examination** should be performed in the ED. Pupils should be checked for size, symmetry and response to light. Lungs should be assessed for ventilation adequacy. Stridor and wheezing may point to underlying upper or lower airway obstruction and asymmetric breath sounds should raise concern for an associated pneumothorax (PTX). Cardiac examination should focus on identifying dysrhythmias, adequacy of circulation assessed by blood pressure and pulse strength in all 4 limbs. Presence of cardiac murmurs should be noted. Low intensity or distant heart sounds should prompt consideration for underlying pericardial tamponade. Abdomen should be assessed for evidence of distension, guarding or presence of pulsatile masses. Rectal exam should be considered to evaluate for gastrointestinal bleeding. The patient should also be assessed for complications related to cardiopulmonary resuscitation (CPR).

All patients presenting with ROSC should undergo a thorough and detailed neurological exam to evaluate mental status (using a validated scale such as the Glasgow Coma Score (GCS)) and identify focal neurological findings. Patients who remain comatose (unable to follow verbal commands or a GCS of ≤ 8) and whose first recorded rhythm was ventricular fibrillation (VF) benefit from Therapeutic Hypothermia (TH) and this should be initiated as soon as feasible.^{10,11}

3.1. Initial workup

The workup should focus on assessing organ function and identifying underlying causes (Table 1).

- A basic metabolic panel including a magnesium level can identify electrolyte abnormalities,¹² a complete blood count with differential may aid in identifying infection or anemia. An arterial blood gas (ABG) permits assessment for acidosis, hypoxia and hypercapnea while providing feedback on ventilatory status. Serum lactate levels are helpful to assess tissue perfusion. Resuscitated patients with elevated lactate levels require serial measurements; greater lactate clearance at 24 h is associated with improved survival.¹³ Baseline coagulation tests and cardiac biomarkers (troponin, CPK-MB) may be obtained and serially followed as needed though the utility of initial troponin levels in directing initial management of patients post-ROSC remains unclear.¹⁴ Toxicology testing can be considered in selected cases, although results rarely change initial management. When available, point-of-care testing should be utilized to expedite clinical decision making.
- A 12-lead ECG should be analyzed in all patients with CA for presence of ST-segment deviation, T-wave abnormalities, dysrhythmias, conduction defects, QT-interval and presence of low voltage (which may indicate tamponade).⁸ An initial as well as repeat 12-lead ECG's are critical for early recognition of ongoing myocardial ischemia and presence of arrhythmias that require treatment. A 64-lead continuous ST mapping obtained using a chest vest may enhance sensitivity and specificity compared to a standard

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