

ECMO AMBULANCE AND ADVANCED EMERGENCY MEDICAL SYSTEM

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Abstract

In our article we propose a way to improve outcomes for out-of-hospital patients suffering from cardiac and circulatory arrest. The quality in providing emergency medical care for these patients varies from state to state, from city to the city. There are cities where the emergency medical system (EMS) personnel declares the death in the patients with circulatory arrest without knowing the real reason of death, after a certain time of cardiac massage, after unsuccessful defibrillations, out of the hospital, on the street. On the other hand, there are cities where the patient is resuscitated on the street/at home, during the time of transport to the hospital, at the hospital and the death is declared only after all, albeit unsuccessful attempts to save patients (at the hospital). From the above it is evident, that we need an interdisciplinary clinical pathway, which helps everyone who is participating in the life saving of these patients. We want to meet our goals of the project using high-tech medical knowledge. VA ECMO implemented by experienced specialists outside the hospital for ensuring oxygenation and blood circulation with the help of a device situated outside the patient regardless of the activity of his heart and lungs, represents the most up-to-date technology.

Keywords

Extracorporeal membrane oxygenation, Emergency medical system, Clinical Guidelines

Introduction

The article proposes new a concept to improve clinical outcomes for out hospital patients suffering from cardiac and circulatory arrest. Out hospital patients with heart and circulatory arrest represent the most at risk cardiac group with the worst results. The quality in provided emergency medical care for these patients varies from state to state, from city to city. The paper proposes interdisciplinary emergency medical care in the frame of advanced emergency medical system (aEMS) by utilizing veno-arterial extracorporeal membranous oxygenation (VA ECMO), which will help not only patients but everyone who is participating in life saving. The ECMO ambulance with aEMS can be applicable mainly in metropolitan areas.

Methods

There are cities where the emergency medical system (EMS) personnel declares death in the patients with circulatory arrest without knowing the real reason of death, after a certain time of

cardiac massage, after unsuccessful defibrillations, out of the hospital and on the street. On the other hand, there are cities where some patient is resuscitated on the street/ at home, during the time of transport to the hospital, at the hospital and death is declared only after all the albeit unsuccessful attempts to save patients (at the hospital). This fact is supported by following case reports:

Case report (Jan Kaplicky, †71). A famous Czech Architect who died at the day of his daughter's birth. He encountered cardiac and circulatory arrest in Prague, Czech Republic; further he experienced resuscitation by bystanders, by EMS personnel; unsuccessful external defibrillations. After 40 min of unsuccessful resuscitation he was declared death on the street without the real cause of death being known. The cause of death was a heart attack (post-mortem).

Case report (Michael Jackson, †50). A famous American artist who encountered cardiac and circulatory arrest in Los Angeles, California; further he experienced resuscitation at home, by EMS personnel during the time of transportation to the hospital and at the hospital. Death was declared

2 hours after his arrival at the hospital. The cause of death was intoxication.

What was similar for both our dearly departed men was cardiac and circulatory arrest and resuscitation by EMS personnel. The differences in their final life courses were the place and cause of death and the time of resuscitation. Another important remark is that EMS personnel in Los Angeles knew that Michael Jackson was Michael Jackson, but EMS personnel in Prague did not recognize the famous architect during resuscitation. The last remark should also call for an extended ethical discussion about who should be resuscitated and who should not and that in the frame of aEMS. Being aged 65 or older should not be considered as a contraindication.

From the above it is evident that we need interdisciplinary cooperation and Interdisciplinary Guidelines for patients suffering from circulatory arrest. We need clearly defined Interdisciplinary Guidelines which help everyone who is participating in the life saving of these patients. There are separate guidelines for EMS personnel and for perfusionists. For example *the ERC guidelines of 2010*¹ provide instructions for how resuscitation should be practiced; *the General Guidelines for all Extracorporeal Life Support (ECLS) cases*² which describes useful and safe practices for patient management during ECMO for specialists in hospital. Both sets of guidelines address patient treatment in detail, but without the involvement of wider interdisciplinary medical care using ECMO outside of the hospital. The suggested interdisciplinary guidelines are meant to solve the problem in the broader context, from the time emergency medical care is started on the arrest circulation on the street till specialized medical care is performed at the Heart center.

The EMS operator and the EMS team are part of the emergency medical care which is found in all metropolitan areas. ECMO operators and ECMO teams are new additions to emergency medical care and are supervised by the Heart center. The Heart center includes a cardiac catheterization lab and surgery rooms. It is better to involve the Heart center in the long-term ventricular assist device program and the heart transplantation program.

The aim is to restore tissue perfusion particularly brain perfusion after cardiac and circulatory arrest as soon as possible. Good communication is the priority and the key to success.

Key points of Interdisciplinary Guidelines for aEMS:

- **Cardiopulmonary resuscitation by bystander**

A patient experiences Heart and Circulatory arrest on the street. Bystanders call an EMS operator. Cardiopulmonary resuscitation (CPR) is performed by bystanders, an EMS operator is willing to help bystanders by phone. An EMS team departs to the place of resuscitation. At the time of cardiopulmonary resuscitation ECMO operator and team are activated.

It is very important to know the total time without oxygen supply, after which new terms are defined: *Time zero* – time at loss of consciousness. *Real Time Zero* – time declared by witness. *Estimated Time Zero* - time at loss of consciousness, without witness

- **Professional resuscitation by EMS team**
EMS personnel continue with cardiopulmonary resuscitation. Repeated external defibrillations are performed if needed (ventricular tachycardia, ventricular fibrillation).

Break point - approx. 25 minutes after *time zero* without a successful resuscitation. ECMO team departs to the place of resuscitation, EMS personnel continue chest compression with cooling aa. Carotis (ice). From the *Break point*, EMS personnel provide cardiac massage with no main attempt at returning of spontaneous circulation (ROSC) but mostly to maintain basal tissue perfusion (brain). It is suitable to utilize chest mechanical compression.

- **Out-hospital ECMO Implantation by ECMO team**

The Implantation of VA ECMO into the groin by skilled specialists outside the hospital. Transport to the Heart Center.

- **Specialized care in the Heart Center**

At the hospital various standard procedures are performed: Selective Coronarography (SCG), Percutaneous Coronary Intervention (PCI), Computed Tomography (CT) and Cardiac surgery procedure if needed. All patients stay at intensive care unit (ICU), supervised by experienced clinicians and perfusionists. After a certain time at ICU attempts at weaning from ECMO are required.

The concept of ECMO ambulance by helicopter has already been established, i.e. at the University of Regensburg, Germany (mostly used for patients with respiratory failure, mostly using veno-venous ECMO)³. ECMO ambulance by car for metropolitan areas in the frame of EMS is a current challenge.

Conclusion

Interdisciplinary Emergency Medical Care with VA ECMO is advanced therapy for out

hospital patients suffering from cardiac and circulation arrest. The suggested methods could dramatically improve their clinical results. Using Interdisciplinary Guidelines and VA ECMO out of hospital for other indications (trauma, drowning) is possible and desirable.

Reference

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