

A case of successful organ donation after extremely prolonged manual cardiopulmonary resuscitation in an avalanche victim

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Abstract

We report a case of a 41-year-old man, victim of accidental avalanche burial, who donated his organs for transplantation after prolonged cardiopulmonary resuscitation and extracorporeal membrane oxygenation.

Introduction

Due to the difficult procurement of organs for transplantation, new technologies and procedures have been developed, and diagnostic and both outpatient and inpatient therapeutic pathways have been improved.

Case Report

A 41-year-old man was accidentally buried in an avalanche during a ski trip. The patient had immediate cardiopulmonary resuscitation

(CPR) upon disinterment provided by bystanders; the initially reported avalanche burial was less than 30 min, there were no trunk midsection, decapitation, whole body frozen solid, airway packed with snow nor gasping referred on extrication which are criteria for not starting CPR. The patient was intubated on the field 80 min after the avalanche, and received 1 mg of adrenaline intravenously because of asystole followed by ventricular fibrillation. After ineffective defibrillation, the decision was made to transport the patient to the Extracorporeal Life Support capable hospital by ambulance with uninterrupted manual CPR because the mechanical compressor device was not available. The end tidal CO₂ was maintained 20 and 22 mmHg during all transport time. On arrival to the Emergency Department the tympanic temperature was 20.3°C. Blood Gas Analysis showed a pH of 6.6 and a K of 4.8 mmol/L, the latter finding suggesting that CPR had been successful in maintaining effective organ perfusion. Chest and abdomen ultrasound were negative for parenchymal lesions and free fluid, indicating that the cause of cardiac arrest was not traumatic. A mechanical compression device (Autopulse, Zoll Medical, Italy) was applied until femoral artery cannulation was performed; extracorporeal membrane oxygenation (ECMO) started after 75 min from admission to the hospital. The patient was progressively warmed until a return of spontaneous circulation (ROSC) was achieved, 7 hours later, upon reaching 32°C (Figure 1). Further inquiry revealed that the initially reported avalanche burial was 60 min. 24 hours after the start of ECMO, a neurological evaluation in normothermia showed the absence of brainstem reflexes. Therefore, death was assessed with neurological criteria in normothermia, as per current Italian law. The patient was declared brain dead. Since the patient had expressed a will of organ donation and the parents were not opposing, the liver and kidneys of the patient were transplanted into 3 recipients. Given the lack of literature to support liver function after a prolonged period of hypothermia, a first hepatologist had expressed a negative opinion despite a normal hepatic biopsy. The liver transplant was then possible after the favorable opinion of a second hepatologist and the informed consent of the recipient, who still enjoys good health.

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Discussion

This case report has several original aspects that deserve discussion if compared to the International Commission for Mountain Emergency Medicine (ICAR MEDCOM-4)¹ recommendations and the Italian *Programma Alba*² for donation after cardiac death. In fact, CPR is not recommended if the burial time is above 60 minutes and the body temperature is below 28 °C.¹ Moreover, the *Programma Alba*² suggests that the no-flow time should not exceed 10 minutes and the low-flow time using mechanical compressor

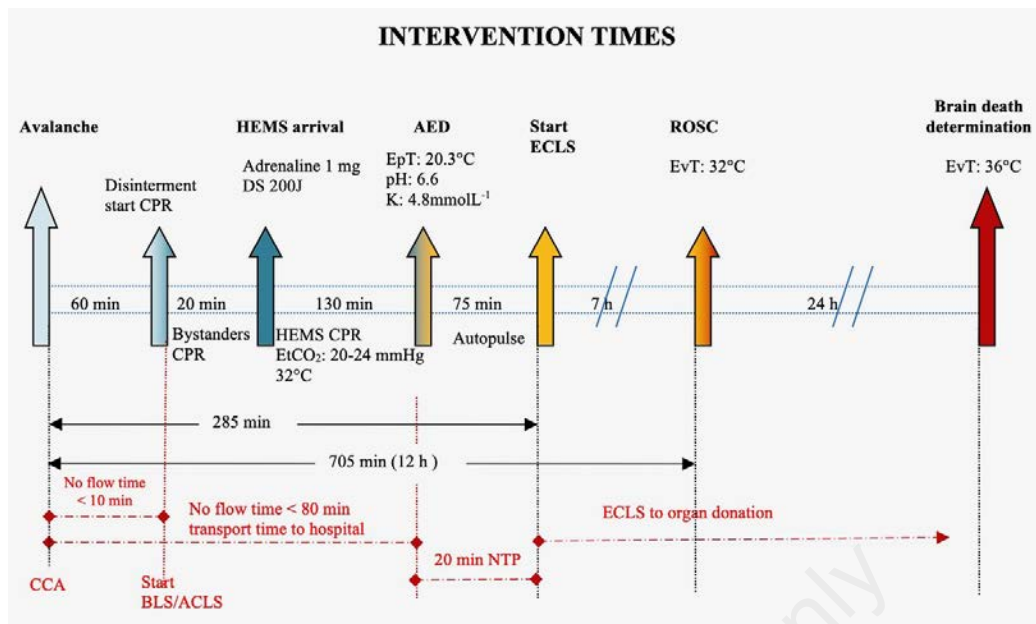


Figure 1. Intervention times. HEMS, helicopter emergency medical service; AED, accident Emergency Department; ECLS, extracorporeal life support; ROSC, return of spontaneous circulation; CPR, cardiopulmonary resuscitation; EpT, epitympanic temperature; EvT, endovascular temperature; EtCO₂, end tidal CO₂; CCA, cardio-circulatory arrest; BLS/ACLS, basic life support/advanced cardiopulmonary life support; NTP, no touch period. In black: case report intervention times. In red: intervention times proposed by the Alba criterion.

should be less than 80 minutes, while these times were 60 minutes and 280 minutes, respectively, in this case. Lastly, the case provides initial evidence of liver resistance under hypothermia conditions. Conceivably, hypothermia played a key role in permitting the successful restoration of circulation and maintenance of organ function.³ The evidence available for hypothermia after cardiac arrest is also uncertain as regards pre-hospital induced hypothermia. With rewarming, a ROSC was observed, but not a return of neurological function, indicating an irreversible hypoxic-ischemic brain damage. For this reason we proceeded to a diagnosis of death with neurological and not cardiac criteria, as per current Italian law.^{4,5}

Conclusions

The development of new technologies, the application of pathways and therapeutic strategies shared among the various specialties and in the intra-extra-hospital settings, have allowed the recruitment of transplantable and still normal-functioning organs. However, further research is needed in this area.

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