

# Full Recovery Case After 82 Minutes Out-of-Hospital Cardiac Arrest: Importance of Chain of Survival and Predicting Outcome

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A middle age man underwent immediate cardiopulmonary resuscitation (CPR) for ventricular fibrillation (VF) occurred in an ambulance. After arrival in a regional hospital, return of spontaneous circulation (ROSC) was achieved 82 minutes after the collapse. He was in coma even three hours after ROSC. So, he was transferred to our university hospital to receive therapeutic hypothermia (TH). An initial bispectral index (BIS) value suggested a favorable outcome. Thus we decided to aggressive therapies including TH of 34°C for 48 hours, followed by a very slow rewarming at the rate of 1°C per day. Eventually he was discharged from the hospital with good neurological state. This case shows us two points: 1) the importance of the chain of survival: CPR done immediately after the collapse, persistent CPR for refractory VF, followed by coronary interventions after ROSC, continuing care to the university hospital, 2) decision making for TH using BIS monitoring.

## Case Report

**A** 61-YEAR-OLD MAN complained of sudden back pain and collapsed in an ambulance on the way to a secondary care hospital. In the ambulance, emergency medical technicians performed cardiopulmonary resuscitation (CPR) with shocks for ventricular fibrillation (VF). After arrival, the medical staff continued CPR for sustained VF. Return of spontaneous circulation (ROSC) was achieved 82 minutes after the collapse. Percutaneous coronary intervention (PCI) reperfused the occluded left anterior descending artery, but he required catecholamines and an intra-aortic balloon pumping (IABP). He was still in coma even 3 hours after ROSC.

We were asked a postcardiac arrest care and dispatched two critical care physicians by a helicopter, and there they cared for the patient and transported him by an ambulance, because the IABP was so heavy that it could not be loaded onto the helicopter.

After arrival at our hospital about 7 hours after ROSC, he still showed coma and unstable hemodynamics. An initial bispectral index (BIS) value under administration of neuromuscular blockade at the emergency department showed 40 and suppression ratio (SR) was zero, which could potentially suggest a favorable outcome. Thus, we decided to aggressive therapies,

including therapeutic hypothermia (TH) of 34°C for 48 hours. The body temperature was controlled with an external cooling device (Arctic Sun; Medivance, Louisville, CO). After 48-hour TH, very slow and controlled rewarming at the rate of 1°C per day was started. IABP and catecholamines were discontinued within day 3. He was discharged from the hospital with CPC 1.

## Discussion

### Arrest time

Neurological outcome after prolonged cardiac arrest may depend on arrest time, including CPR duration (Oddo *et al.*, 2008). A case of complete recovery after CPR for 59 minutes was reported (Zimmermann *et al.*, 2014). To the best of our knowledge, the present case has the longest CPR time for 82 minutes. According to previous studies (Oddo *et al.*, 2008; Zimmermann *et al.*, 2014), one might think TH would not be as effective for such a prolonged arrest time. Our patient showed BIS values, under administration of neuromuscular blockade soon after admission, ranging from 30 to 50 with zero SRs. These values could indicate a favorable outcome for ROSC patients (Seder *et al.*, 2010; Aibiki *et al.*, 2012). So, we decided to induce TH for the current case even showing very unstable hemodynamics.

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One might speculate that the BIS values and SRs in the emergency department showed potential for good recovery even without TH. However, there are no definitive studies showing that BIS values reported in the current case can help 100% to predict a favorable outcome in PCAS patients. So, it is uncertain whether the patient reported in this article would have recovered completely if not treated with TH.

This case has an arrest time for 82 minutes, so that TH for 48 hours done in this case, which has a longer period than those done in the United States or European countries, might be effective, since it has been reported that, though in animals, after a prolonged arrest time, hypothermia for 48 hours decreases the number of hippocampal neuronal death as compared to that for 24 hours (Che *et al.*, 2011). Another interesting point is the time to initiation of TH. TH in this case was induced several hours after ROSC, which might be beyond the range of exerting the beneficial effects of TH. However, it is well known that in an animal model, delayed postischemic hypothermia provides effective and long-lasting neuroprotection although depending on the delay to initiation, duration, and degree of cooling (Colbourne *et al.*, 1995). Furthermore, a large scale of registry study showed that there is no significant association between the time to start of TH and outcome (Nielsen *et al.*, 2009). Therefore, in the future, it is required to test a hypothesis whether in post-cardiac arrest patients, delayed hypothermia commencing from several hours after ROSC, like in the current case, has neuroprotective effects.

#### *Chain of survival*

The Japan Resuscitation Council 2010 guidelines emphasize the importance of chain of survival (The Japan Resuscitation Guidelines, 2010). The benefit of using a medical helicopter is to transfer physicians and patients in the shortest possible time. Although the helicopter could not transfer the current patient with IABP because of the overload in the ambulance returning to our hospital, helicopter-transported physicians were able to provide a care similar to that in the tertiary care hospital. This case shows us two crucial points: (1) the importance of the chain of survival: CPR done by Emergency Medical Personnel immediately after the collapse, persistent CPR despite refractory VF, followed by excellent PCI treatments after ROSC in the second care hospital, and continuing care until arrival at the university hospital and (2) a decision-making for TH using BIS monitoring.

#### **Author Disclosure Statement**

No competing financial interests exist.

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