# Survival With Complete Neurological Recovery After Prolonged Resuscitation

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**Citation**

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**Abstract**

The ideal duration of cardiac resuscitation is unknown. Typically prolonged cardiopulmonary resuscitation is associated with poor neurologic outcomes and reduced long term survival. No consensus statement has been made and traditionally efforts are usually terminated after 15 – 30 minutes. We present a case of severe cardiomyopathy who developed multi-organ failure followed by cardiac arrest. He was resuscitated for nearly 2 hours and survived with good long-term outcome.

Duration of Resuscitation that results in futility of care is unknown. Our patient is an exceptional case, as his multiple comorbidities would imply an extremely poor prognosis for which early cessation of resuscitation would be justified. However, given his young age and suspicion of a correctable lesion, we opted to prolong resuscitation with good results. This case report exemplifies the fact that CPR duration should be established on a case-by-case basis and take into account many determinants of survival. No single factor is predictive of outcome, so the clinician must integrate all the circumstances of the arrest and the patient's premorbid condition when making the decision to terminate resuscitative efforts.

Prolonged cardiac arrest is generally not associated with a good outcome. The mortality in these cases is very high and the patients who survive are usually left with neurological sequelae. Case reports of complete neurological recovery after prolonged cardiac arrest are few and far in between. Our case is unique in that his Premorbid Conditions of Severe Ischemic Cardiomyopathy, Grade 4 Acute Pancreatitis, STEMI with In-Stent Thrombosis, AKI and DKA would all imply a Very Poor prognosis. Traditionally common practice would recommend stopping resuscitation after 15-30 minutes, but our decision to continue until the patient was in the cath lab, resulted in a good outcome with complete neurologic recovery.

## INTRODUCTION

The Ideal Duration of Cardiac resuscitation is unknown. To date both the American Heart Association (AHA) and the European Resuscitation Council (ERC) make no consensus statement on how long such procedures should be carried out for. Typically after 15-30 minutes of CPR, if there is a poor prognosis and no possibility of a good neurologic outcome, then most physicians cease resuscitative efforts.
We present here a case of severe cardiomyopathy who developed STEMI and multiorgan failure. During recovery he suffered PEA and VF arrest for which he was resuscitated under ACLS protocol for 1 hour and 49 minutes. He subsequently had a good neurologic outcome after repeat cardiac catheterization.

## CASE REPORT

A 46 year old Guyanese male with a past medical history significant for Hypertension, Diabetes and alcoholism presented to the Emergency room with one day history of cramping diffuse abdominal pain. One night prior to presentation, the patient had a few beers to drink after which he noted gradual onset abdominal pain followed by 4 episodes of vomiting which was non-bilious and non-bloody. The constant pain was 10/10 in severity, non-radiating and associated with nausea. He denied fevers, dysuria, malodorous urine, diarrhea, constipation, chest pain, cough, dyspnea, weight loss, polyuria and polydipsia. His Last meal consisted of chicken and his last bowel movement was of normal consistency one day prior to presentation.

He was diagnosed with hypertension 6 years ago and type 2 diabetes 4 years ago. The patient had a right inguinal hernia repair 10 years earlier. He was poorly compliant on Enalapril 20 mg po daily, Metformin 500mg po bid and had no known allergies. He drinks 1.5L of Vodka 3 days per week (Last Drink was 1 day prior to presentation). The patient does not smoke nor uses illicit drugs. His mother is alive with hypertension and diabetes and his father suffered from stroke

and died from myocardial infarction.

Vitals on admission were; blood pressure 134/93, pulse 101, respiratory rate 22, saturation 98% RA, and temperature 97.5F. Physical exam was remarkable for jugulo-venous distention, painful abdominal distention and epigastric tenderness with a negative Murphy's sign. Significant labs included Lipase 2085, AST 357, ALT 175. Abdominal Ultrasound was negative for gall bladder disease but CT Abdomen revealed fatty hepatomegaly and pancreatic edema with peri-pancreatic stranding and fluid. He was assessed as Acute Pancreatitis secondary to Alcohol Abuse and subsequently started on IV Fluids, Morphine, Pantoprazole, and Lorazepam for possible alcoholic withdrawal. After CT Abdomen, the patient developed Acute Kidney Injury likely secondary to IV contrast in the setting of worsening pancreatitis and prior ACE-I use. Over the next two days his creatinine rose to 4.3mg/dl, while developing alcoholic hepatitis with AST:ALT Ratio 1039: 106, decreased Urine Output and Diabetic Keto-Acidosis (DKA). He was transferred to the Intensive Care Unit (ICU) for further IV fluid and Antibiotic Management with Meropenem.

On Day 3, he was intubated for airway protection following an episode of delirium tremens. Routine EKG later showed 3 mm ST Segment Elevation in V2-V4, characteristic of STEMI for which 'Code Heart' was called. He was taken to Cath Lab and found to have 80% Stenosis in the left anterior descending (LAD) and circumflex (LCX) coronaries. A Bare Metal Stent was placed in the LAD and he was started on an Eptifibatide and Heparin drip. Additionally he had decreased left ventricular systolic function with an EF of 30% and SBP of 90. An intra-aortic balloon pump (IABP) was subsequently placed to to decrease myocardial work and improve coronary perfusion.

After a week, as his DKA resolved on insulin and bicarbonate drip, repeat imaging showed Grade 4 pancreatitis with retroperitoneal collections. The patient started spiking fevers, however repeat cultures were consistently negative. Even though Cardiac Output was maintained with pressors and IABP, his non-oliguric renal failure worsened. He was thus briefly placed on Hemodialysis prior to being taken back 1 week later for Bare Metal Stent placement in LCX. After a total of two weeks his pulmonary edema and atelectasis improved such that he could be extubated. The patient was transferred to telemetry with an EF of 40%.

The following day, he initially complained of shortness of breath after receiving 1 unit of PRBC for an H/H of 8.4/24.5. Physical exam and chest x-ray revealed mild pulmonary edema, so IV Lasix was given. That afternoon he desaturated and pulmonary embolism was suspected so a V/Q Scan and Doppler Ultrasound of his legs were ordered, and these failed to show any evidence of thromboembolism.

At 7:14pm, He became pulseless for which a 'Code Blue' was called. CPR was started with administration of epinephrine. The initial rhythm was asystole. He had Return of Spontaneous Circulation (ROSC) after 2 mins but then again became pulseless in Ventricular Fibrillation (VF). He was defbrillated and then loaded with amiodarone. MgSO4, CaCl and 3 ampules of sodium bicarbonate were given. Having had ROSC for about 4 mins he then again went into multiple episodes of PEA followed by Asystole. In total he had 13 doses of epinephrine administered under ACLS guidelines.

EKG was reviewed and he was suspected of having In-Stent Thrombosis, so a decision was made on repeat intervention. CPR was continued as patient was taken back to the Cath lab. He was resuscitated for a total of 1 hour and 49 mins. During Cath, the patient was found to have 100% occlusion of his LCX which was managed with angioplasty and a another intra-aortic balloon pump was placed. Repeat Echo a day later showed a decrease in EF to 15% with infero-apical akinesis. After 3 days he was extubated and the dobutamine as well as the IABP was discontinued.

Because of recurrent fever spikes and persistent hypotension, ongoing sepsis was suspected. As such, cultures were drawn and a repeat CT abdomen done revealed multiple retroperitonal collections and necrotizing pancreatitis. Being a poor surgical candidate, this was managed with placement of several drains under radiological guidance. Cultures returned positive for E. Coli in his retroperitoneal abscess. Over the next few weeks, he was intermittently managed with broad spectrum antibiotics, pressors, strict fluid management and typical CHF protocol medications. He clinically improved as his abdominal drains were removed. The patient was sent home with a life vest for 3 months and subsequently returned for Single Chamber ICD placement in May 2012. He currently does well and follows up regularly in our Cardiac Clinic.

## DISCUSSION

In 1965 Stemmler conducted a small study of 103 patients

for whom the average resuscitation time was 15-30 mins. Since then most physicians have adopted this as the relative time for cessation of resuscitation if there is no ROSC. Unfortunately little progress has been made to determine the ideal time for stopping resuscitative efforts and the AHA and ERC (European Resuscitation Council) currently make no definitive statement on when resuscitation attempts should be terminated. Studies have shown that for prolonged resuscitation in a patient with cardiac arrest for more than 12-15 minutes is an independent predictor of death and studies done in the Emergency Room showed an improved outcome with a total resuscitation time of less than 15 minutes. Furthermore many argue against prolonged resuscitation as the Cost per patient for a relatively poor outcome can range in the tens of thousands.

Recently, Goldberger et al (Sept 2012) did an observational study of 64,339 patients with cardiac arrest for whom resuscitation was attempted. Of these, hospitals which resuscitated patients for an average of 25 minutes had better overall survival to discharge (adjusted risk ratio 1.12, 95% CI 1.02–1.23; p<0.021) and ROSC (adjusted risk ratio 1.12, 95% CI 1.06–1.18; p<0.0001) as compared to those hospitals who resuscitated for an average of 16 minutes. The neurologic outcome was independent of the duration of resuscitation and they recommended prolonging current resuscitation attempts by 10 – 15 minutes. They further suggested that once resuscitation was started, the additional time would only have minor effects on added resources.

From our literature search, the case report with the lengthiest prolonged resuscitation with good long term outcome was by Stoneham et al in 1992 where a 30 year old man attempted suicide by near-drowning. Once rescued, he was found hypothermic (23OC) and received 4.5hrs of CPR. Five days later he was discharged with no neurologic deficit.

As suggested by Nolan et al, it is difficult to establish an ideal resuscitation time, as many factors contribute to CPR duration across various hospitals.9 Besides the experience of the Rapid Response team, the clinical scenario and institutional capabilities (such as the ability to provide Therapeutic Hypothermia, ECMO and PCI) come into play to determine total resuscitation time. Ideally, termination of resuscitation efforts should occur when there is no further chance of survival or meaningful neurologic recovery. However, as an example, patients that are younger with few comorbidities may have longer attempts as a reversible cause of cardiac arrest is identified and treated.

Additionally, bedside echocardiography can be used to identify tamponade or evaluate for cardiac kinetic motion. Wall motion suggests the possibility that PEA has been inadequately resuscitated, whereas the absence of activity is associated with death. The use of this modality to determine the end of resuscitative efforts varies from hospital to hospital and is more commonly done in the ER.

One exception to the standard guidelines for termination of resuscitation is hypothermic cardiac arrest. Because of the protective effects of hypothermia, several cases of good neurologic recovery after prolonged resuscitation from hypothermic cardiac arrest have been documented.
In these cases, Resuscitative efforts should be continued until the patient has been rewarmed to a core temperature of 30–32°C (86–90°F). The likelihood of survival and intact neurologic function diminish as the duration of the resuscitation attempt increases. The responsible clinician should stop the resuscitation attempt if there is a high degree of certainty that the patient will not respond to further ACLS.

Like our case the examples above are exceptional. The sample size in each are relatively too small to make a definitive recommendation on duration of Resuscitative efforts. The most likely exception is Goldberg's study using the "Get With It Guidelines".Factors which make a consensus statement difficult, include the fact that some studies include Pre-Hospital Arrest, where the down time is unknown and Intra-Operative arrest where a number of hemodynamic and anesthetic factors come into play. The physician must therefore make a decision on duration on a case by case basis. Despite the extremely long period of cardiac arrest, we attribute his good outcome to effective compressions, timely administration of cardiac medications and close adherence to ACLS protocols. To date, the patient has done well with no residual cognitive deficit or neurologic sequelae. This case demonstrates that seemingly desperate long term resuscitation may sometimes be successful.

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